NOAA FISHERIES

Alaska Region

Essential Fish Habitat - EFH

Considerations for Dredge Operations: Mitigation Measures and Case Studies from Alaska

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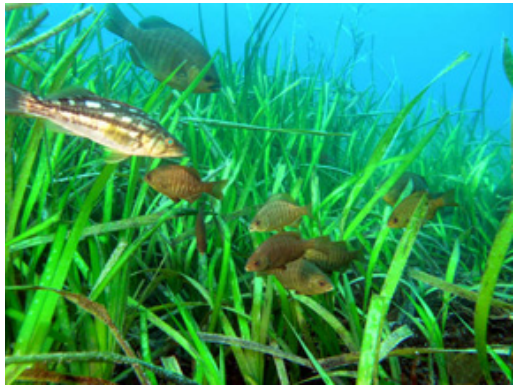
What is Essential Fish Habitat?

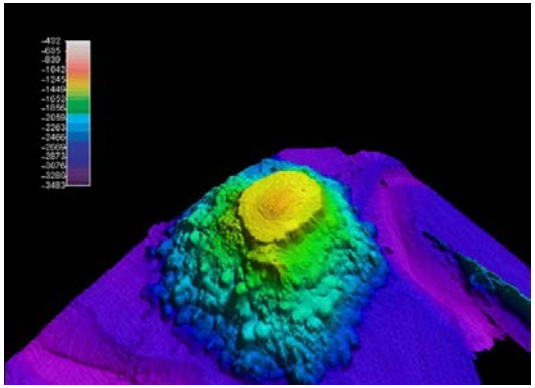
Essential Fish Habitat (EFH) is defined as 'those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity.'

EFH provisions are within the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended through January 17, 2007.

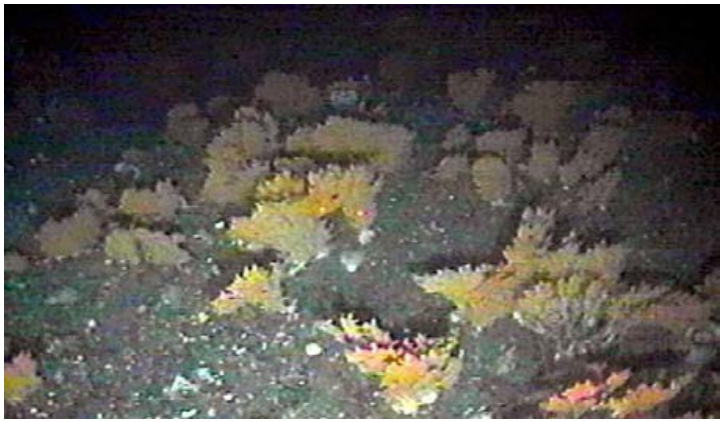
- Section 305(b) of the MSA requires federal fishery management plans (FMPs) to:
  - 1) identify EFH;
  - 2) identify adverse effects from fishing and non-fishing activities;
  - 3) ensure conservation and enhancement of EFH.

What Does EFH Look Like?





EFH includes the physical, chemical, and biological properties of the aquatic areas that fish use as well as the sediment, hard bottom, structures, and associated biological communities.



EFH Regulations

Section 305(b) of the MSA requires Federal action agencies to consult with NOAA fisheries on activities that may adversely effect EFH.

NOAA Fisheries is required to recommend measures to conserve EFH

Recommended measures are advisory only.

Adverse effects may be:

- direct or indirect
- physical, chemical, or biological
- affecting waters or substrate
- loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components.

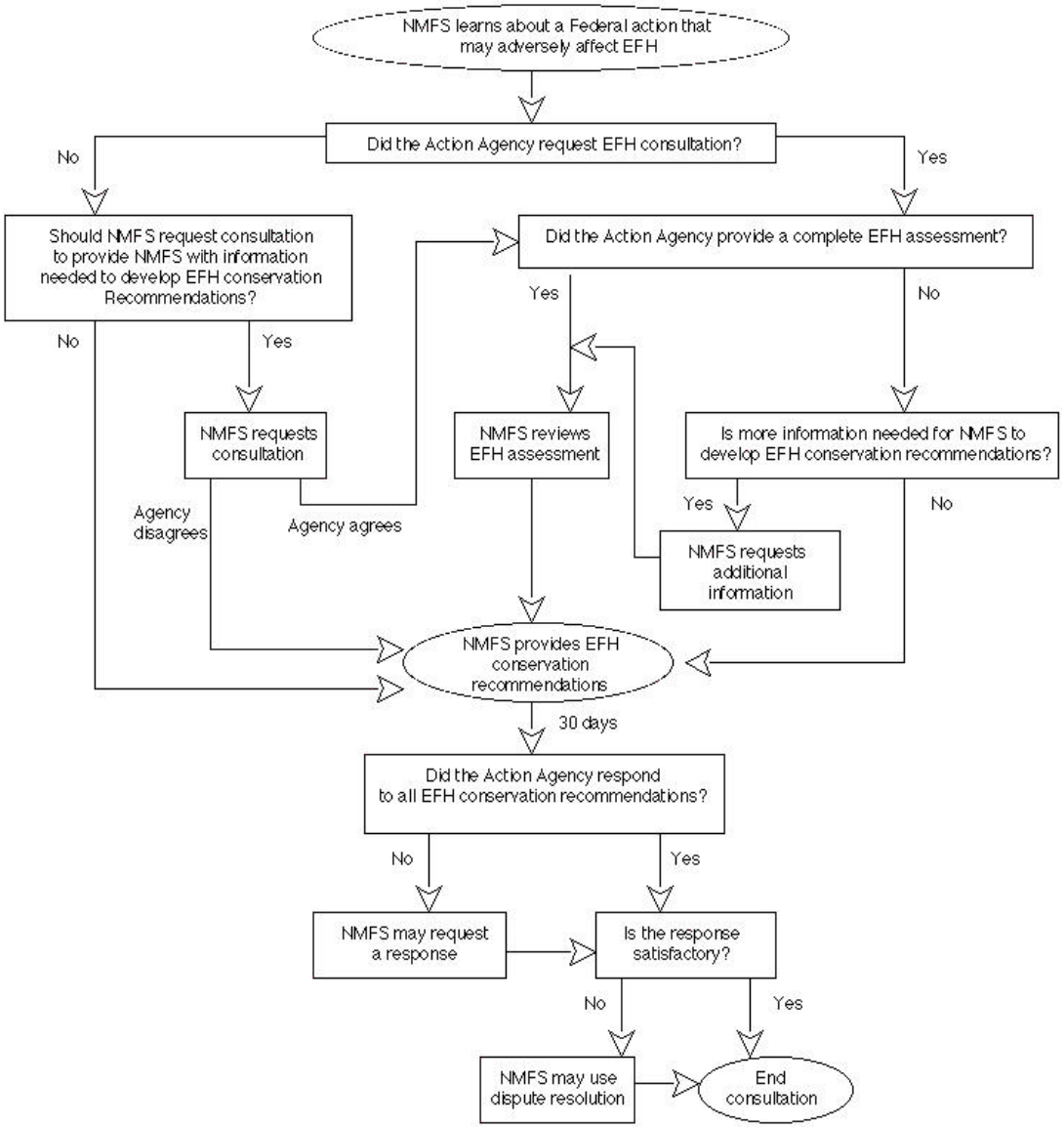
EFH Consultation – Why?

- ✓ Legal: Satisfies legal requirement for Federal action agencies to comply with the MSA.
- ✓ Mechanism: Creates a transparent discussion of the effects that Federal actions may have on marine resources that are necessary to sustain habitats that support federally-managed fish stocks.
- ✓ Desired Result: Decisions support the continued productivity of sustainable fishery resources.

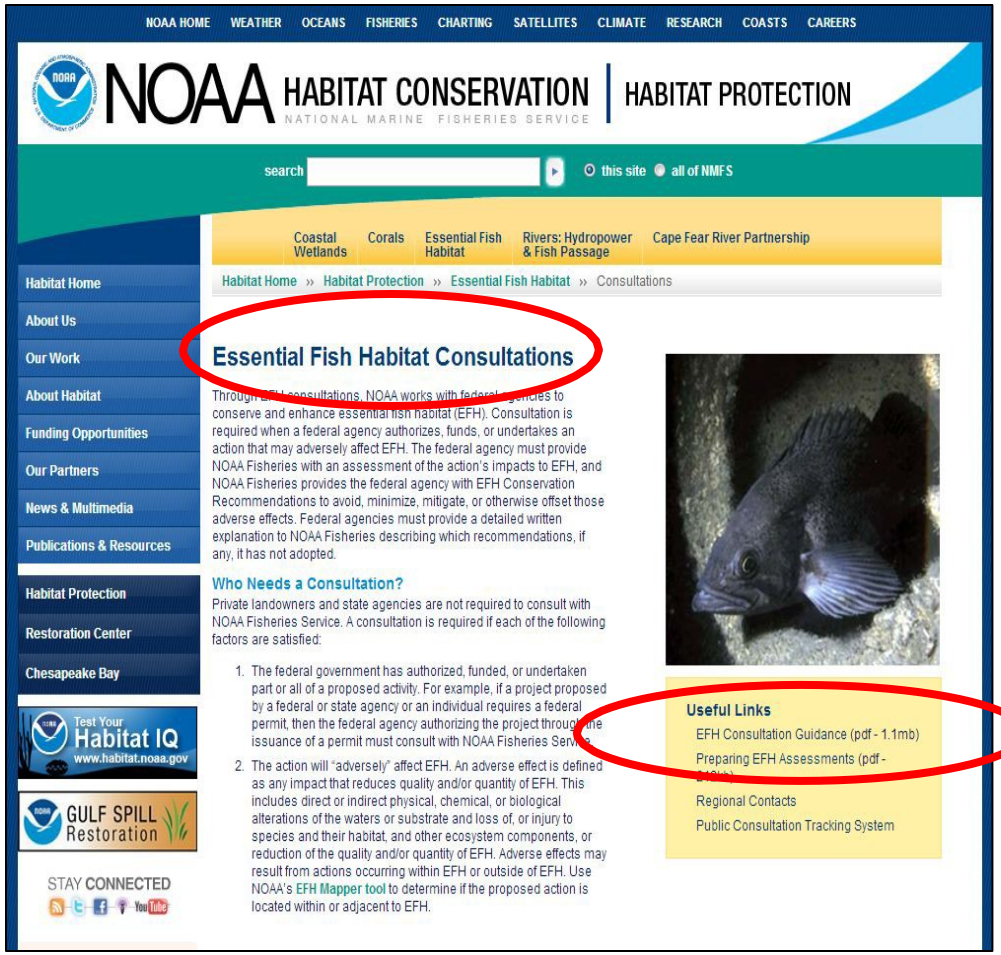
EFH Consultation – Process Overview

- ✓ Federal action agency determines whether or not their actions may adversely affect EFH.
- ✓ An EFH Assessment is required if an action may adversely affect EFH
- ✓ NOAA Fisheries reviews any EFH Assessment and provides conservation recommendations, if required.
- ✓ Federal agency responds to NOAA Fisheries as to whether or not they accept the Conservation Recommendations.
- ✓ NOAA Fisheries may ask for an expanded consultation, if needed.

NMFS Decision Tree for EFH Consultations



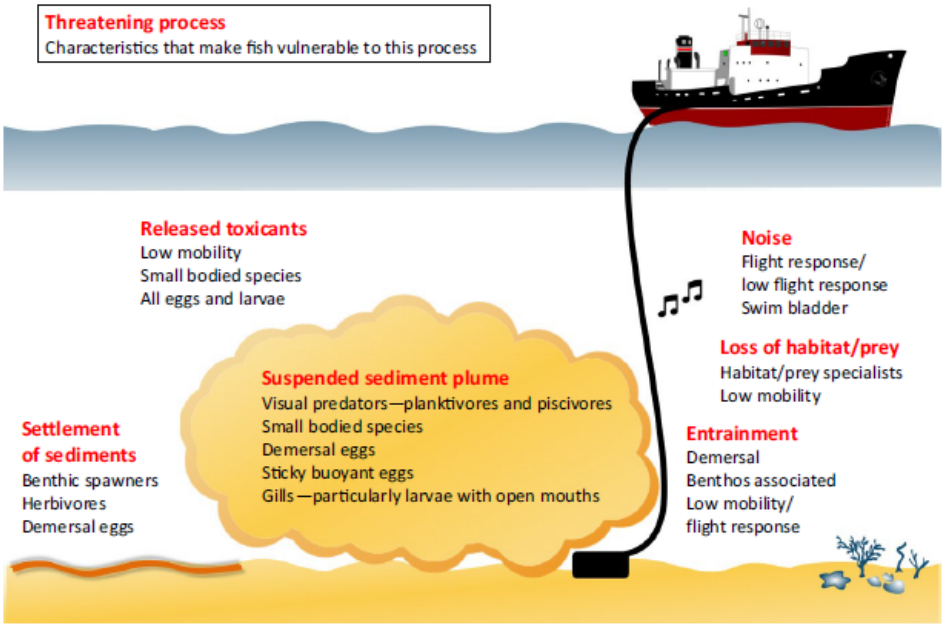
EFH Consultation Guidance



http://www.habitat.noaa.gov/pdf/efhconsultationguidancev1_1.pdf

Possible Adverse Effects of Dredging to EFH

Dredging can cause direct mortality of fish and damage or removal of crucial ecosystem components.

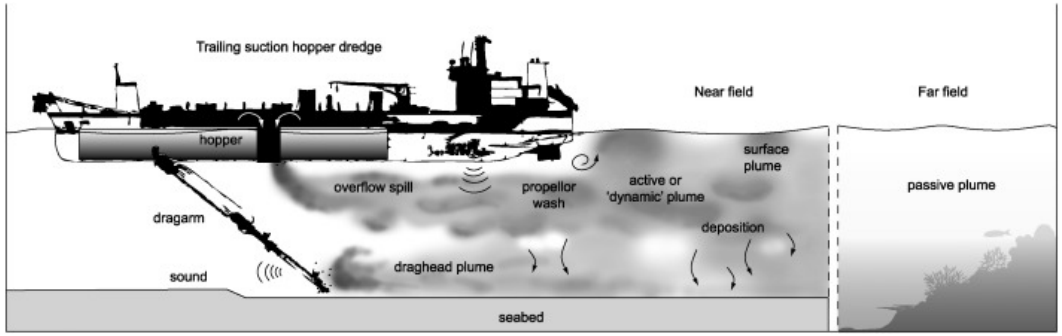


Wenger et. al 2016

Dredging-related stressors can directly elicit responses and affect growth and behavior of fish across all aquatic ecosystems and all life-history stages

Possible Adverse Effects of Dredging to EFH

Suspended Sediment



Direct Mortality

Sediment from dredging can cause reductions in hatching success and survival

Behavioral Changes

- Avoidance of foraging and breeding grounds
- Disrupt ability to respond to chemical cues and may reduce settlement success and survival

Physiological Effects

- Damage to gill tissue and structure, impairing respiratory ability

Susceptibility

- Eggs and larval life stages more susceptible
- Severity of impact increases with sediment concentration and duration of exposure

Possible Adverse Effects of Dredging to EFH

Hydraulic Entrainment

Entrainment is the direct uptake of aquatic organisms caused by the suction field generated by hydraulic dredges.

A hydraulic hopper dredge

Mortality Impacts

- Dredging can result in a reduction of species diversity and total number of individuals

Susceptibility

- All life cycle phases
- Benthic fauna (mussel, snails, crustaceans, worms, echinoderms, etc.) are especially vulnerable

Environmental Factors

- Low impact: dynamic areas of high natural stress such as shallow mobile sands
- High impacts: more stable deep water gravel environments

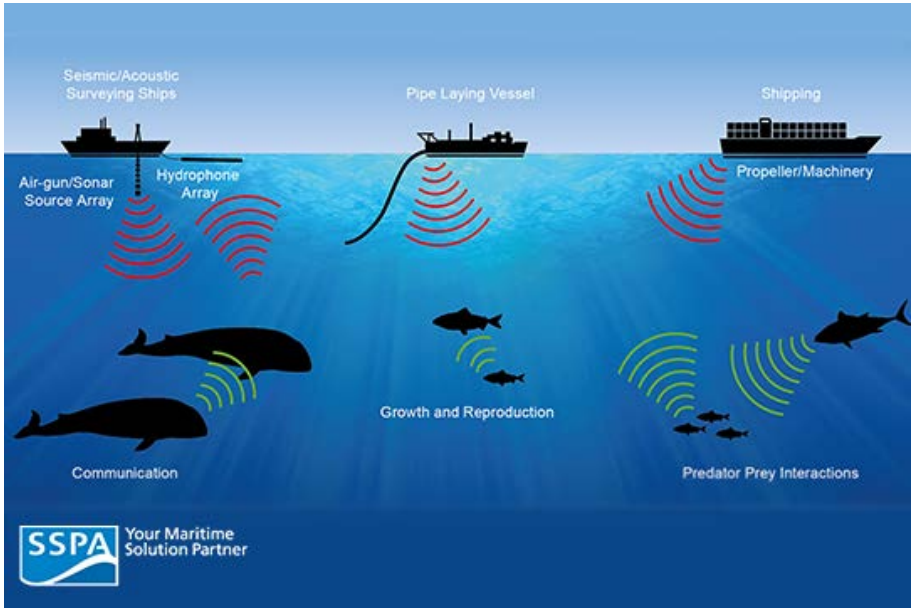
Possible Adverse Effects of Dredging to EFH

Underwater Noise

Studies have shown that noise characterized by amplitude and frequency fluctuation, like that of dredging, can elicit a significant stress response.

Behavioral Impacts

- Block or delay migration of anadromous fishes
- Impede ability to hear biologically relevant sound
- Interrupt or impair acoustic communication
- Impact foraging behavior
- Impede predator avoidance



Combined with effects of sedimentation, dredging noise can elicit avoidance responses in marine fishes and can drastically change how they utilize essential habitat.

What to Do with this Information?

In the process of planning and executing a dredging project, there are a few important factors to consider with respect to equipment type, timing, and other variables.

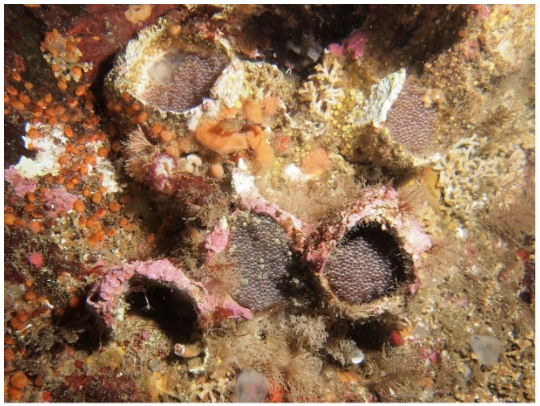
Careful consideration of the following variables will help all parties collaborate to develop a plan and mitigating factors that is both efficient for the project and as safe and sustainable for fish habitat as possible.

Environmental Factors to Consider

Population of Waterway at Time of Project

Are there anadromous streams nearby? When are the migration periods for these streams through the project area?

salmon migrating to spawn in an anadromous stream in Alaska



Kelp greenling eggs laid in giant barnacles

When is the larval recruitment period for the species in the area?

Mitigation

- **Timing windows:** implement seasonal restrictions to avoid impacts to habitat during species critical life history stages such as spawning and egg/larval development periods.
- **Migratory Corridors**

Environmental Factors to Consider

Aquatic Vegetation

- Submerged aquatic vegetation (SAV) provide key ecological services to aquatic and marine habitats.
- Risk of removal or burial
- Increased sedimentation and turbidity can interrupt photosynthesis and reduce primary productivity of the area.

Mitigation

- Avoid disposing of dredged material in wetlands, SAV, and other special aquatic sites whenever possible.
- Assess all options, including upland disposal sites, for the disposal of dredged materials and select disposal sites that minimize adverse effects to EFH.

Environmental Factors to Consider

Substrate Type

Different substrate types have different abilities to recover from dredging

- Fine particles → slow settling velocities → prolonged sediment suspension

- Sand/gravel: rapid resettlement

What is contained in the substrate?

- Dredging can re-suspend bottom sediments and release nutrients, toxic metals, hydrocrabons, hydrophobic organics, pesticides, and pathogens

Environmental Factors to Consider

Hydrodynamic Regimes

The shape and hydrodynamic regime of the waterway can drastically change entrainment rates of fish.

Narrow river projects: higher entrainment rates, more likely anadromous species

Expansive harbors and bays: lower entrainment rates, more likely estuarine and marine species

Environmental Factors to Consider

Hydrodynamic Regimes

Dredging may also modify current patterns and water circulation via alterations to substrate morphology.

- Changes in direction or velocity of water flow, water circulation, or dimensions of waterbody → alterations of fish utilization of habitat for food, shelter, reproduction

Mitigation

- Determine a reasonable background turbidity level based on regular monitoring
- Establish turbidity limits

Environmental Factors to Consider

Hydrodynamic Regimes – Other Effects

Current Strength

- Strong currents: up to three years recolonization
- Weaker currents: 5 to 10 years recolonization

Water Temperature

- Cold waters: slower recolonization
- Temperature and bathymetry can vary noise levels and frequencies from dredging activity.

Mitigation

- Locate dredging activities (e.g., placement of piers, docks, marinas) in deeper water or designed to minimize the need for maintenance dredging.

Environmental Factors to Consider

Dredging Equipment

The type of dredging equipment and specifics of the dredging process can greatly impact the severity of adverse effects on EFH.

- Dredging equipment that increase turbidity
  - increase turbidity → reduced light → lower rate of photosynthesis for SAV →lower primary productivity

- Different equipment have different sound levels and frequencies.

Mitigation

- Best Management Practices (BMPs)
  - limit turbidity, sedimentation, and noise.
  - silt fences, coffer dams, and operational modifications (e.g., use of hydraulic dredge instead of mechanical dredge).

Environmental Factors to Consider

Fate of Dredged Material

As previously mentioned, the location of deposited dredge spoils can have long-term adverse impacts on essential habitat of an area.

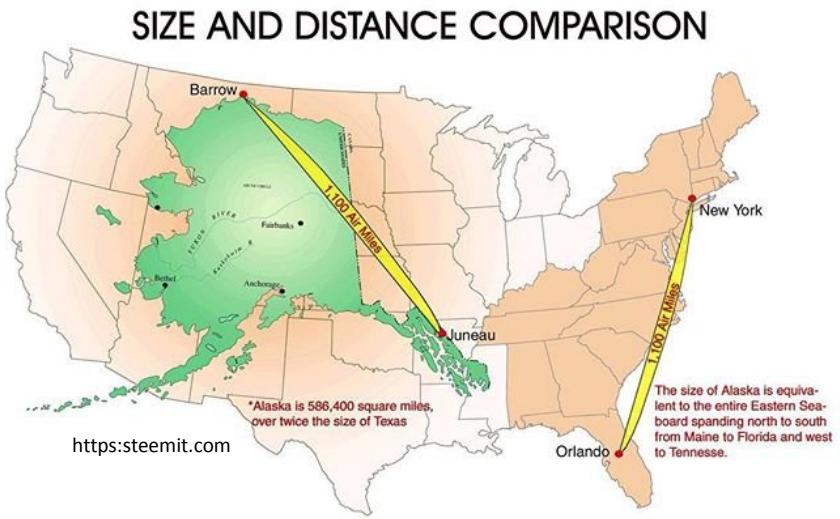
- In water
  - Suspended material may react with dissolved oxygen in the water → oxygen depletion
  - Spoils may smother submerged aquatic vegetation
- On land
  - Wetland habitat is especially sensitive
    - Degraded water quality, alter hydrodynamic regimes, reduce production of important food sources, etc.

Dredge spoils (if uncontaminated) can also be used in a beneficial way to create aquatic and marine habitat, e.g. beach nourishment, reef creation, etc.

Case Study
Note: Alaska is special

The Alaskan coastline extends for 6,640 miles, a distance greater than that of all the other states' coastlines combined. Including islands, Alaska has 33,904 miles of shoreline. The estimated tidal shoreline, including islands, inlets sounds and bays, is 47,300 **miles.**

Approximately **150 miles** are developed (e.g., harbors, seawalls, urban) (estimate shorezone.com)



Case Study: Nome, Alaska

Nome is a historic gold mining community on Alaska's Norton Sound Coast. It is also home to a vital harbor that supplies mining, oil and gas operations, and over 50 outlying communities.

The harbor site is on an exposed stretch of low-relief sand and gravel coastline.

Nome

Population around 4,000 people

Nome: Environmental Considerations

Pacific Salmon EFH

- Important cultural and nutritional resource
- Marine and freshwater harvest
- Adults spawn mid-July through fall
- Eggs deposited in stream bed emerge as fish in April/May of following year
- Eggs are extremely vulnerable to disturbance
- Suction dredges generaly prohibited in salmon areas except May 15- July 15

Nome: Environmental Considerations

Norton Sound Red King Crab EFH

- Only commercially important benthic invertebrate in the area
- Lives under ice for 5 to 6 months per year
- Reproduction happens in March through June in nearshore waters, shallow waters
- Larvae drift for 2-5 months before settling into benthic habitats
- Young crab (< 1 year) live in cobble, avoid mud/silt
- Young Juveniles live in shell hash/cobble, algae
- Older juveniles form pods and travel together, feeding at night and are vulnerable to dredging activities

Nome: Environmental Considerations

Naturally Occurring Arsenic

- Notably high concentrations (up to 200 mg/kg)
- Mostly due to local mineralogy.
- 1995 and 1996: burial of material within the harbor basin under a 3.3 ft (1 meter) thick cap
- Turbid water due to load of sediment discharged by Yukon River

Arsenic concentrations in Nome sediment samples (Photo: USACE)

- These sediments, once deposited on the sea floor, can be readily resuspended by severe storms, especially given the shallow depths throughout Norton Sound.

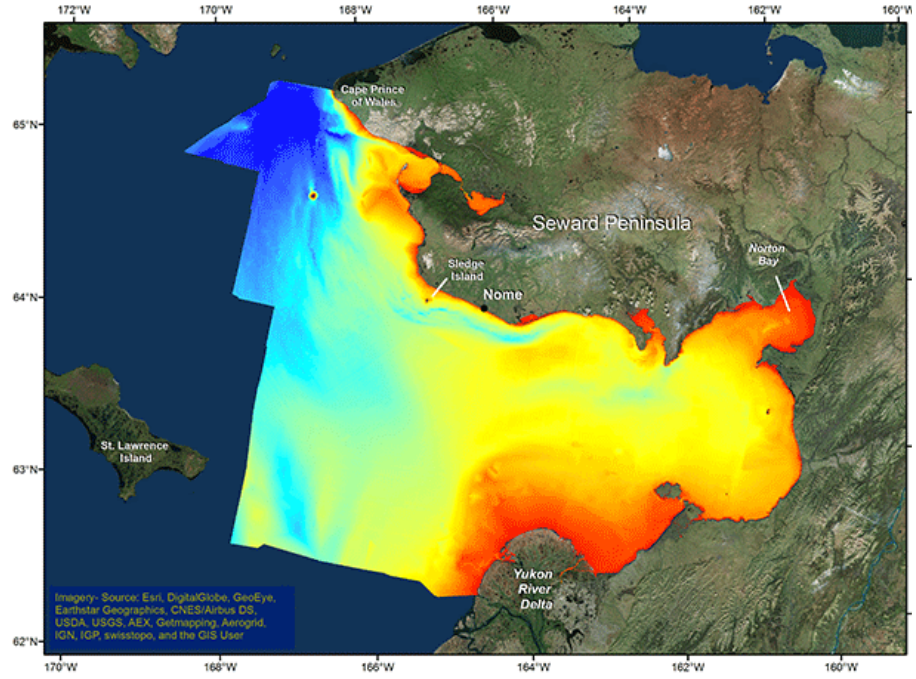
Nome Dredging Activities: Placer Mining

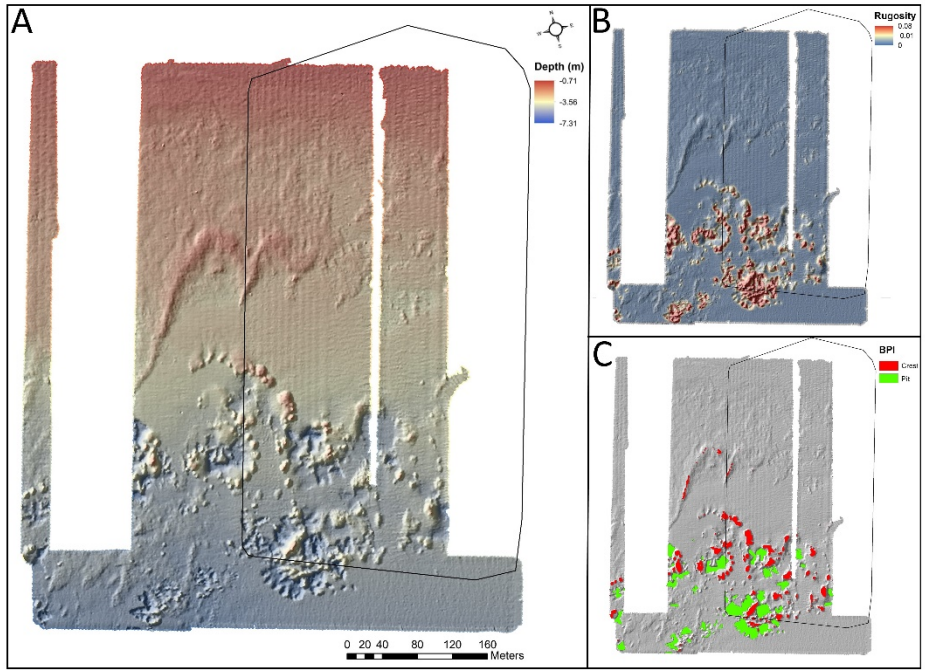
Placer Mining: Mitigation

Average Depth 13m or 43ft. Seasonal 'Ice Scour'' depth 9.1m or 30ft.
*Shallower in recent years

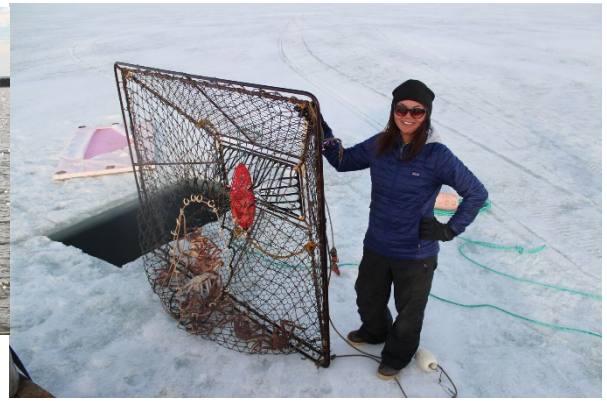
EFH Mitigation:

- Timing windows (salmon and crab) migrations ;
- Dredge depth limit at 9.1m or 30ft contour

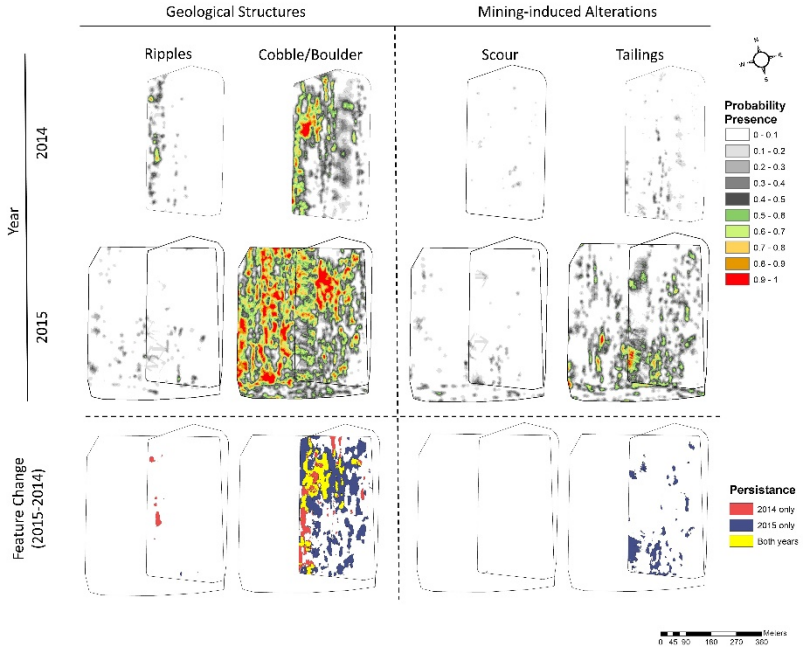




Bathymetry Research



Harris; Baldwin-Shaeffer
Alaska Pacific University
& NOAA (preliminary data)



Nome Dredging Activities: Maintenance Dredging

Nome Harbor Maintenance Dredging

- **Inner entrance channel:**4,000 cubic yards (CY) of sediment where depths vary from -22 feet mean lower low water (MLLW) to -10 feet MLLW.
- **Outer channel:** 10,000 CY (22 feet MLLW)
- **Sediment trap:** 15,000 CY (-22 feet MLLW)
- **Harbor basin:** 5,000 CY (-10 feet MLLW).

Dredging works will be early May to late July, depending on the "ice out" conditions.

Maintenance Dredging: Mitigation

Timing

- Commence work when ice goes out
- Inner channel completed by 25 June
- Rest of the project area completed by 31 July.

Timing window justification

- protects juvenile salmon, which start out-migration from Snake River in mid-June.
- Prevents entrainment of NSRKC juveniles that settle out of the water column in August
- Prevents disturbance of the benthos during this vulnerable life stage.

Maintenance Dredging: Mitigation

Modifications to the harbor have been made to enhance EFH.

- Previous harbor entrance channel was filled in,
- New channel was breached through the Snake River sand spit
- Protected outer approach channel formed by building a new breakwater

Causeway and the new breakwater are both breached near shore to facilitate the passage/migration of marine organisms (e.g., crab, salmon), small watercraft, and some sediment.

Conclusions

- **NOAA recommends that industry stakeholders initiate correspondence early in the planning stages of a dredge project to effectively minimize adverse effects on EFH.**

- **Communication with NOAA prior to the development of a formal EFH Assessment can help stakeholders incorporate the most relevant science and effective mitigation measures into their assessment.**

- **Such forethought and careful planning can help to meet the goals of the dredging operation and meet NOAA's mission to manage, conserve, and protect living marine resources in inland, coastal, and offshore waters of the United States.**