Auke Bay Fisheries Laboratory

National Marine Fisheries Service
11305 Glacier Highway
Juneau, Alaska, U.S. 99801

Pink Salmon Spawning Habitat Recovery After the *Exxon Valdez* Oil Spill

Michael L. Murphy, Ronald A. Heintz, Jeffrey W. Short, and Stanley D. Rice

Oil Still Toxic to Salmon 4 Years After Spill

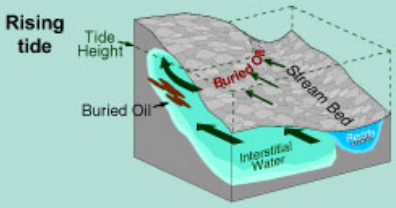
This project examines recovery of pink salmon spawning areas in Prince William Sound after the 1989 *Exxon Valdez* oil spill. The spill caused long-term toxicological and probable genetic damage in salmon that incubated as embryos in oiled streams. **Impact:** Embryo mortality was still greater in salmon from oiled streams through 1993, 4 years after the spill.

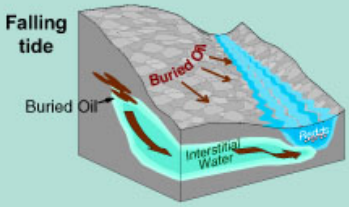
Spawned-out pink salmon in oiled stream, Prince William Sound, September 1990. Salmon embryos were potentially exposed to oil for long periods as oil leached from stream banks to the spawning gravel. Photo by ADF&G.

Objectives

- Document oil levels in pink salmon streams in 1989.
- Assess recovery in 1995.
- Relate to effects on embryo mortality in pink salmon.

How does a marine oil spill contaminate salmon streams?

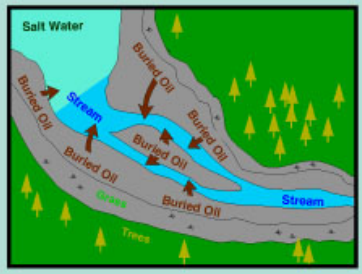




Buried oil on stream deltas can contaminate salmon redds by leaching into streams during ebb tide. Rising tides lift interstitial water through buried oil in the "bathtub ring" near the high water line. Falling tides let contaminated interstitial water run downslope, below the beach surface, into the streambed and salmon redds.

The "Bathtub Ring"

Oil from a marine spill deposits in a "bathtub ring" on beaches and intertidal stream sections where pink salmon spawn. Every tide can move hydrocarbons from oil buried high on adjoining beaches into the stream gravel.



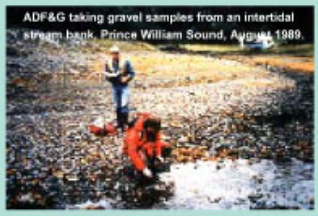
Update: Another study finds oil still plentiful on some Prince William Sound beaches in 1997.

Exxon Valdez oil is still plentiful 0-10 cm deep in beach sediment at Sleepy Bay, 8 years after the oil spill. This finding supports results from stream deltas.

Field Sampling

1989-90 — Alaska Dept. of Fish and Game (ADF&G) samples 200 stream deltas in Prince William Sound.

1995 — Auke Bay Laboratory resamples 12 streams, analyzes samples.

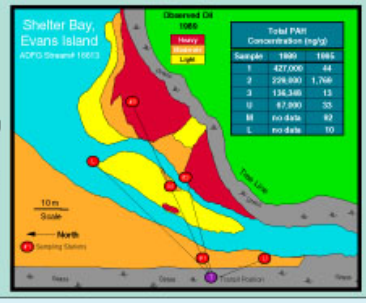


ADF&G taking gravel samples from an intertidal stream bank, Prince William Sound, August 1989.

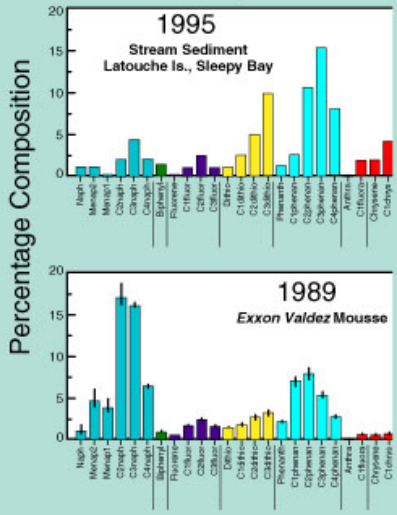
Then and Now...

In 1989, ADF&G mapped seven stream deltas to establish sampling stations. These same stations were resampled in 1995.

Chart shows oil con-centrations in 1989 and 1995.

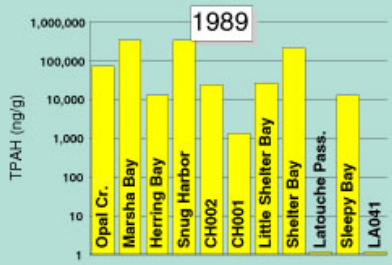


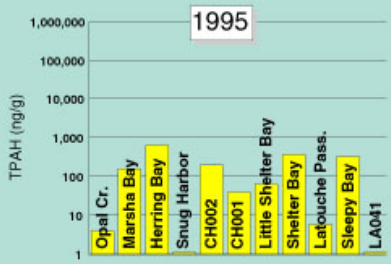
Profile: The composition of PAHs (i.e., the "profile") shows the source of oil and state of weathering.

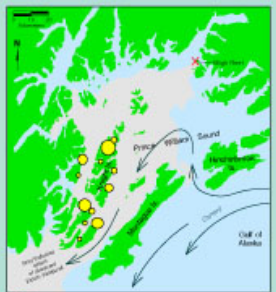


Conclusions: The 1995 profile (top) matches *Exxon Valdez* mousse and is moderately weathered. The heavier, more toxic components predominate in the weathered oil.

Results: Total Polynuclear Aromatic Hydrocarbons (TPAH)







= 1995 sampling sites. Size indicates mean TPAH concentration, from 1 ng/g to a maximum of 664 ng/g.

Conclusions

- Oil concentration in stream deltas was sufficient to increase embryo mortality in pink salmon for at least 4 years after the spill.
- Although many streams had recovered by 1995, some still had significant levels of toxic weathered oil.
- Such oil levels in sediment -- as low as 3,800 ng/g -- have been associated with impaired survival of pink salmon embryos in the laboratory.