Exxon Valdez Oil Spill: Long Term persistence and and Long term effects

Looking back after 20 years

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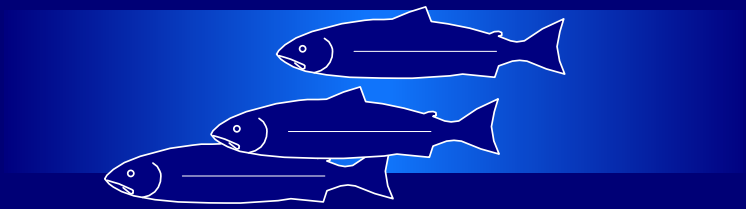


Comparisons & Lessons Learned

Exxon Valdez - 1989

Deepwater Horizon 2010

Bottom Line:

What did we learn with EV that informs DWH spill?

For Alaskans, the oil spill is NOT over!

Exxon Valdez Oil Spill 1989

When will the spill be over?

The Spill will be over when:

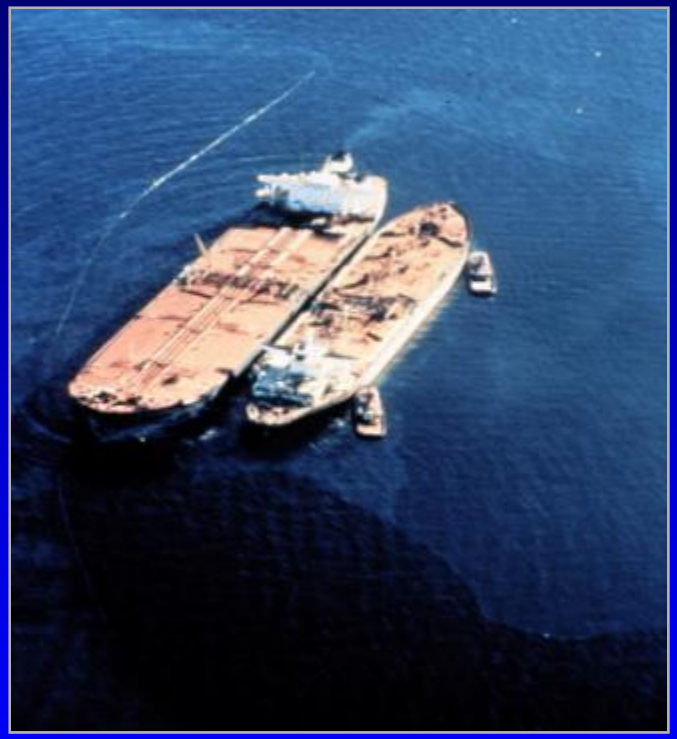
1. No more litigation
2. No more oil
3. No more Effects

The Spill will be over when:

1. No more litigation
2. No more oil
3. No more Effects

Right Now- 0 for 3

The Spill will be over when:



"No more litigation"

2 or 3 law suits settled,

- 1991 natural resource settlement
- 1995 civil case

3. Reopener clause- pending

First: quick comparison of both spill events

PWS Exxon Valdez Oil spill

GOM Deepwater Horizon Oil spill

Second: 5 big wows from the Exxon Valdez spill

First: Quick comparison of both spill events

PWS Exxon Valdez Oil spill	GOM Deepwater Horizon Oil spill

No two spill events are the same

First: Quick comparison of both spill events

PWS Exxon Valdez Oil spill		GOM Deepwater Horizon Oil spill
	No two spill events are the same	
	Event scale	
11 M Gal	Volume of oil	250 M Gal
3 day	first land fall	40 day
Viscous	Oil chemistry	Light thin
NO	Dispersants	1 M Gal
NO	Burning	Yes
NO	Skimming	Yes
3	Politics	85

First: Quick comparison of both spill events

PWS Exxon Valdez Oil spill	GOM Deepwater Horizon Oil spill
No two spill events are the same	
$1 B settlement	?
Most studied spill, ever	?

Exxon Valdez Oil Spill: 1989

Spill Event

Long Term persistence

Long term Effects

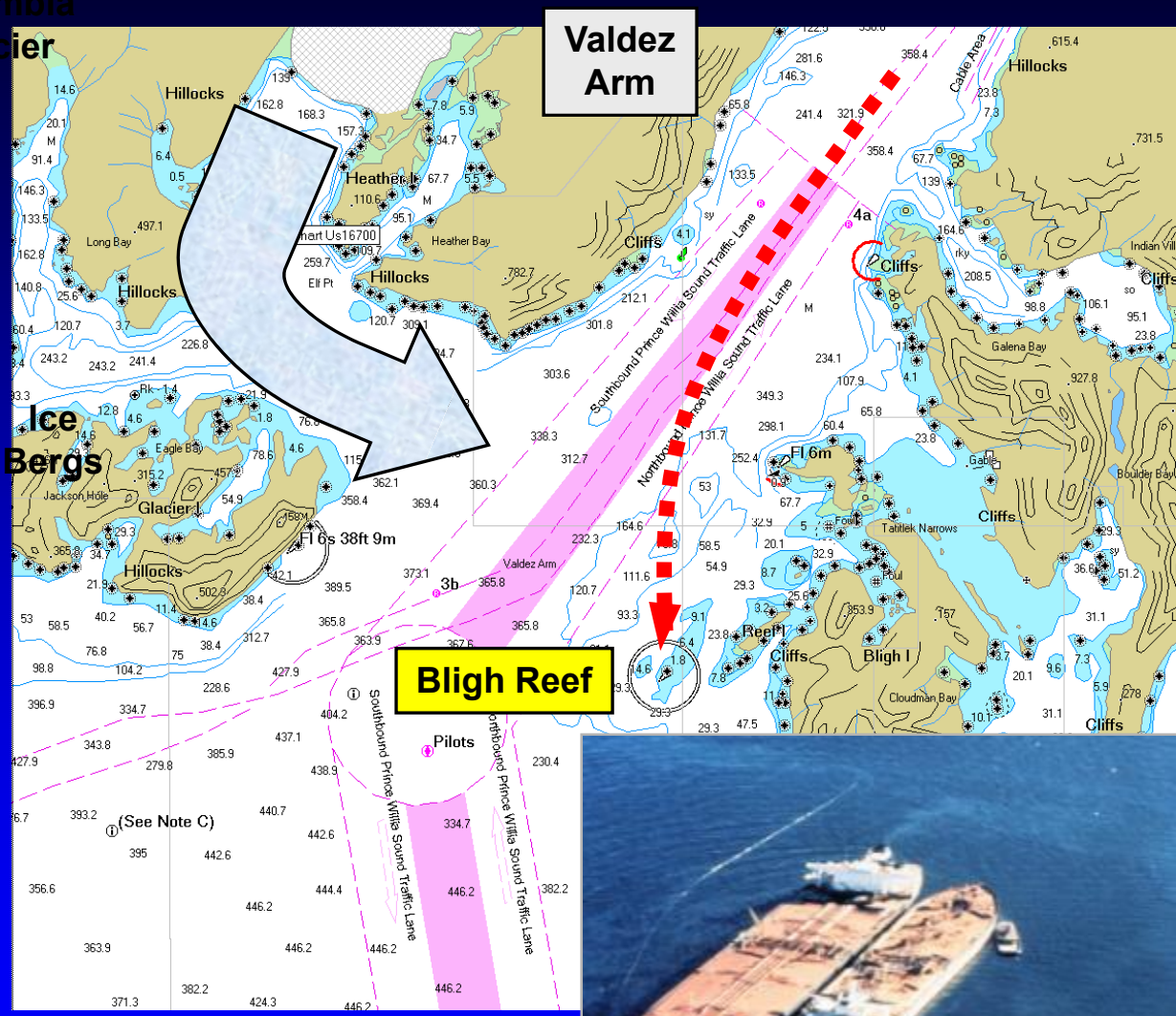
Good Friday- 1989

Exxon Valdez –

Goes off course

Grounds out on Bligh Reef

8 of 11 Cargo Tanks are "torn open"



Highest priority- liter remaining cargo off

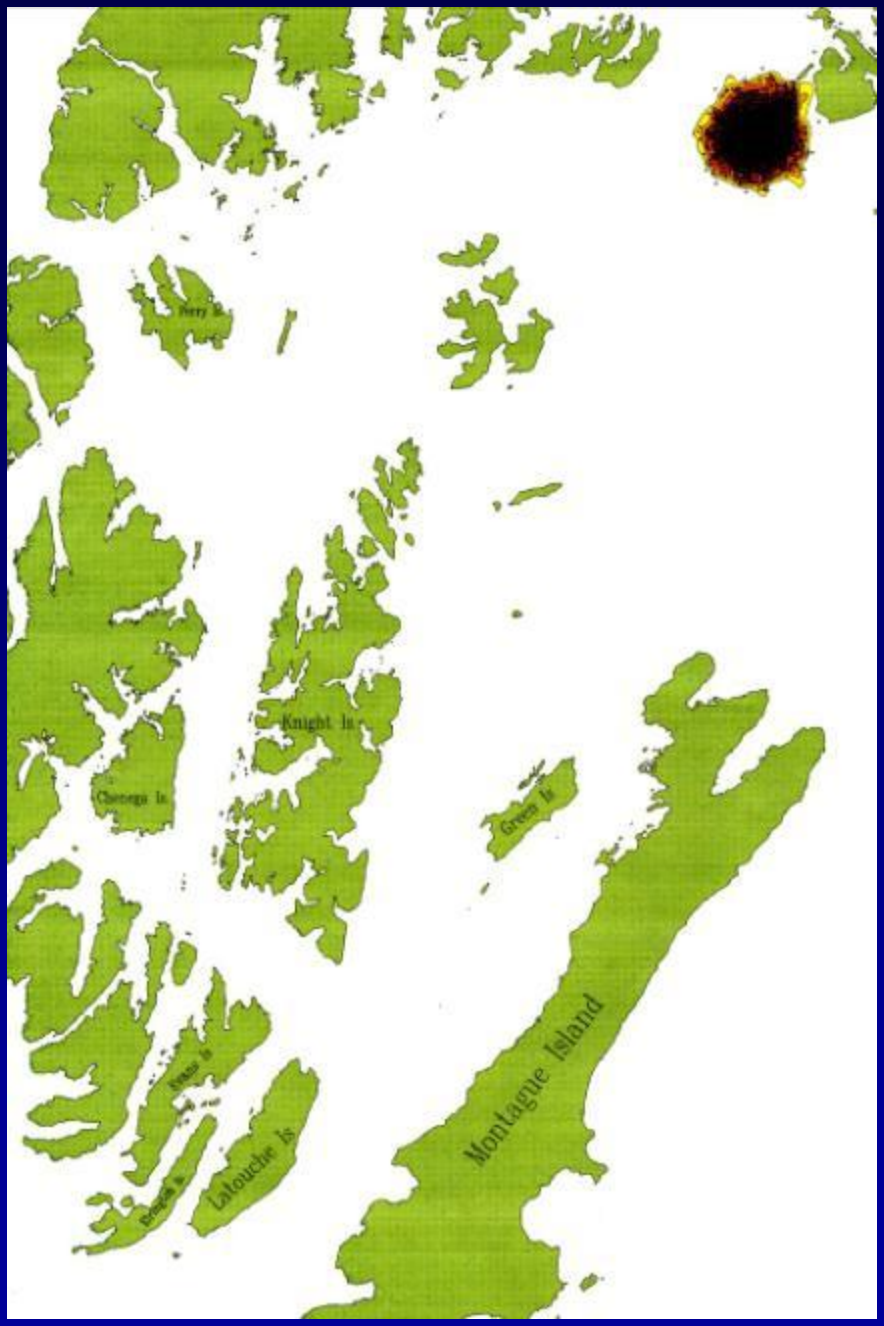
Exxon Valdez Oil Spill

NOAA HAZMAT Trajectory Model

March 24, 1989 **Day One**

Legend

- 53 particles/sq mile
- 53 to 13 particles/sq mile
- 13 to 3 particles/sq mile
- 3 to 1 particles/sq mile
- Each particle represents ~1,100 gallons of oil (twenty 55 gallon drums)



J.A. Galt et al. 1991

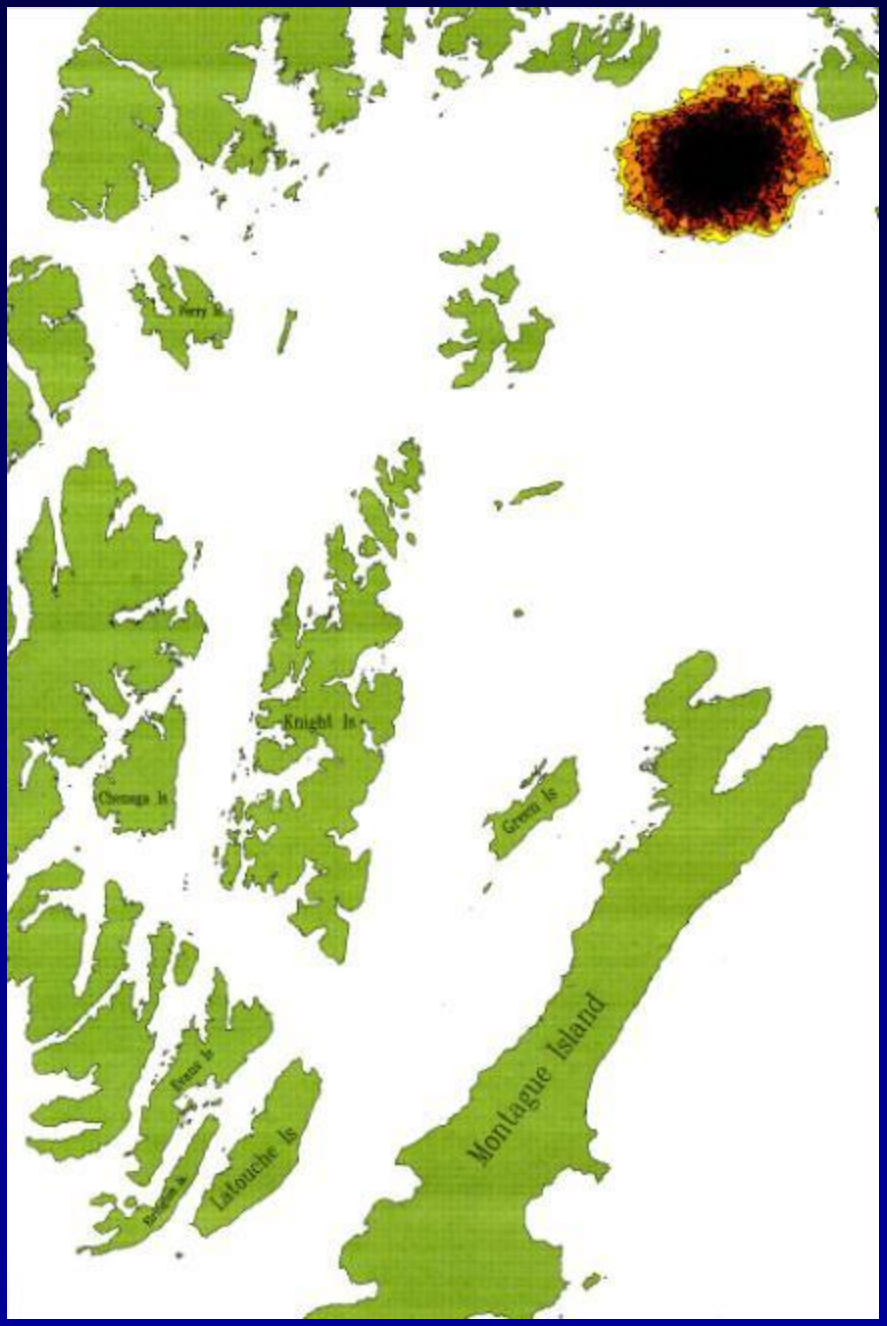
Exxon Valdez Oil Spill

NOAA HAZMAT Trajectory Model

March 25, 1989 **Day Two**

Legend

- 53 particles/sq mile
- 53 to 13 particles/sq mile
- 13 to 3 particles/sq mile
- 3 to 1 particles/sq mile
- Each particle represents ~1,100 gallons of oil (twenty 55 gallon drums)



J.A. Galt et al. 1991

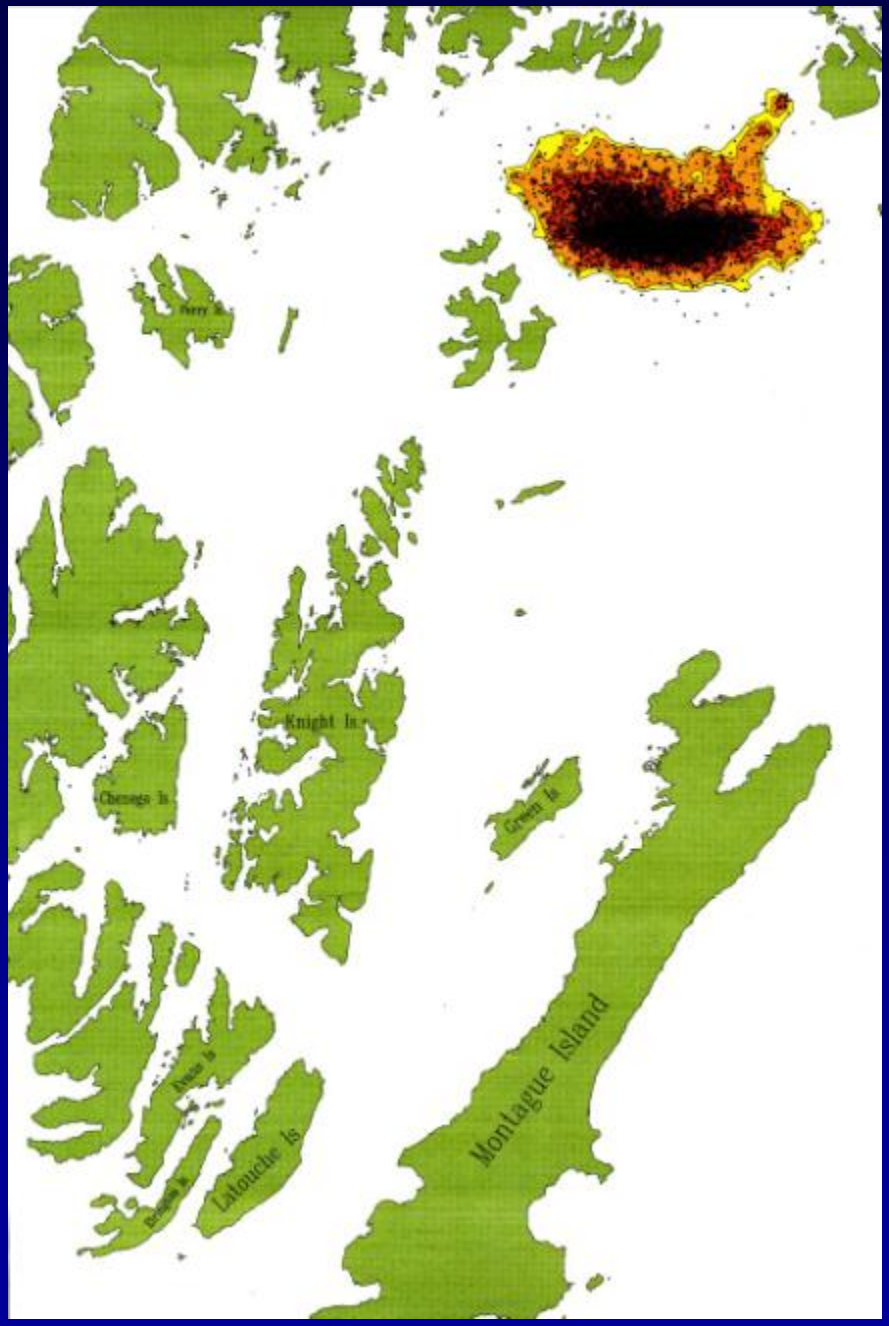
Exxon Valdez Oil Spill

NOAA HAZMAT Trajectory Model

March 26, 1989 **Day Three**

Legend

- 53 particles/sq mile
- 53 to 13 particles/sq mile
- 13 to 3 particles/sq mile
- 3 to 1 particles/sq mile
- Each particle represents ~1,100 gallons of oil (twenty 55 gallon drums)



J.A. Galt et al. 1991

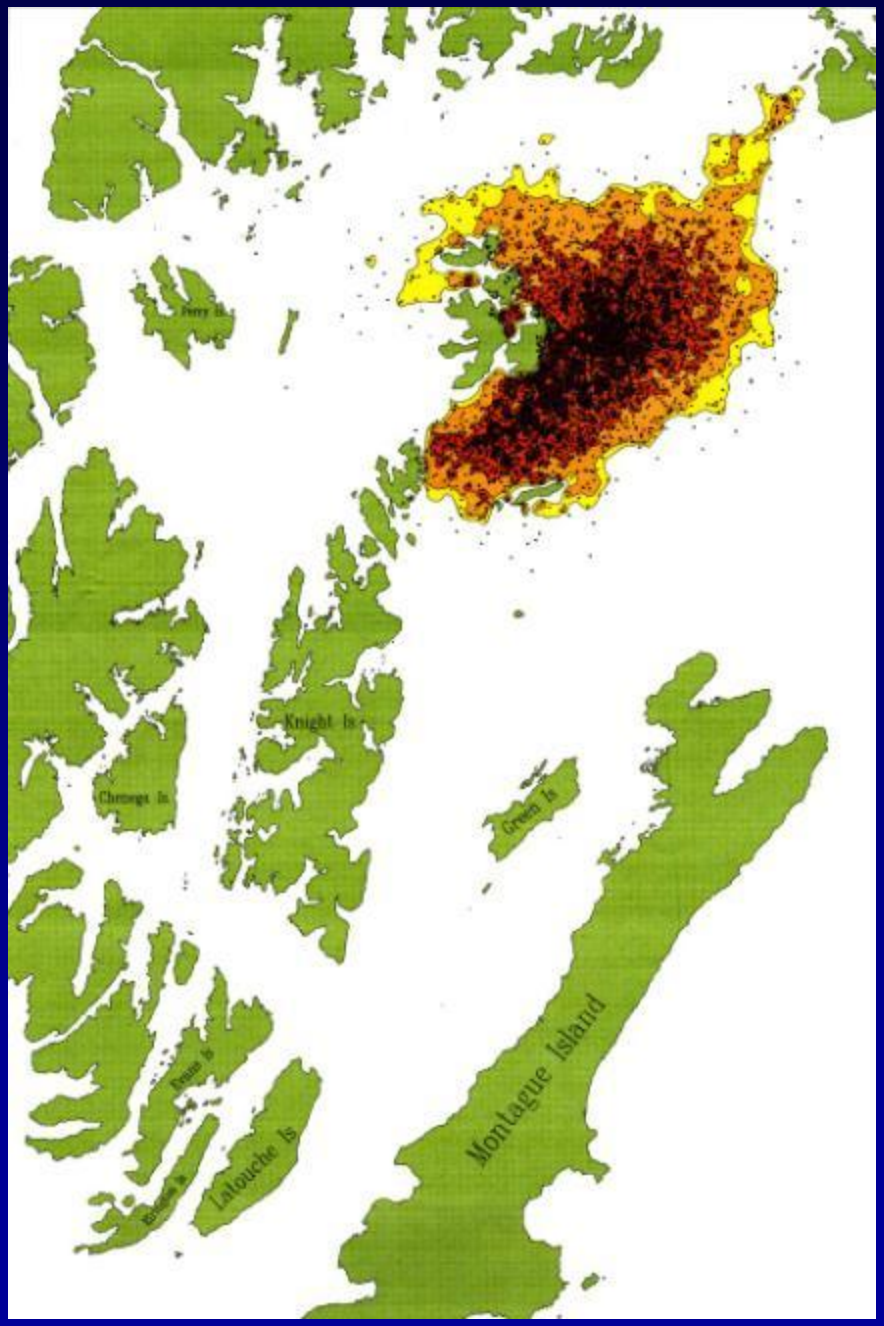
Exxon Valdez Oil Spill

NOAA HAZMAT Trajectory Model

March 27, 1989 **Day Four**

Legend

- 53 particles/sq mile
- 53 to 13 particles/sq mile
- 13 to 3 particles/sq mile
- 3 to 1 particles/sq mile
- Each particle represents ~1,100 gallons of oil (twenty 55 gallon drums)



J.A. Galt et al. 1991

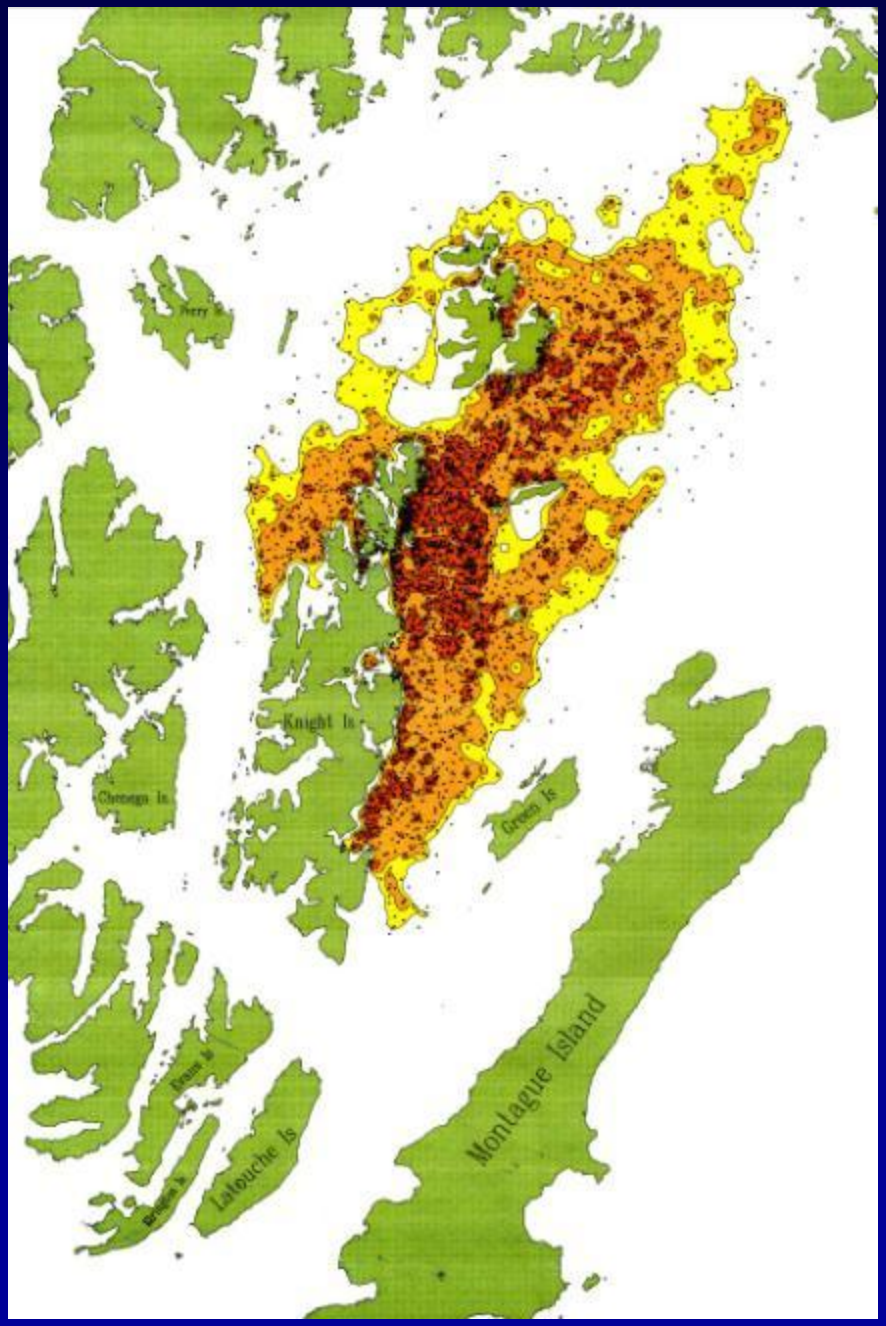
Exxon Valdez Oil Spill

NOAA HAZMAT Trajectory Model

March 28, 1989 **Day Five**

Legend

- 53 particles/sq mile
- 53 to 13 particles/sq mile
- 13 to 3 particles/sq mile
- 3 to 1 particles/sq mile
- Each particle represents ~1,100 gallons of oil (twenty 55 gallon drums)



J.A. Galt et al. 1991

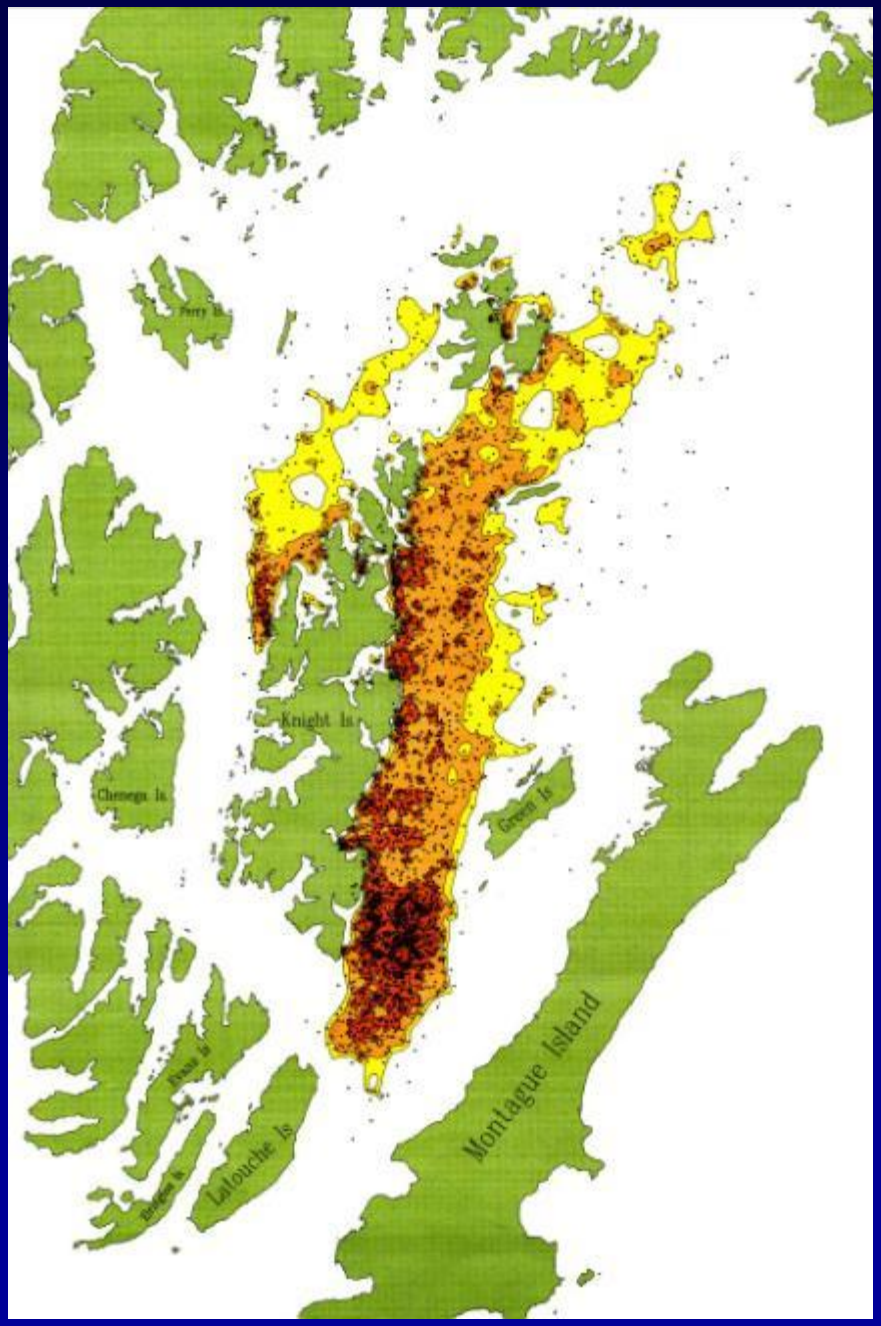
Exxon Valdez Oil Spill

NOAA HAZMAT Trajectory Model

March 29, 1989 **Day Six**

Legend

- 53 particles/sq mile
- 53 to 13 particles/sq mile
- 13 to 3 particles/sq mile
- 3 to 1 particles/sq mile
- Each particle represents ~1,100 gallons of oil (twenty 55 gallon drums)



J.A. Galt et al. 1991

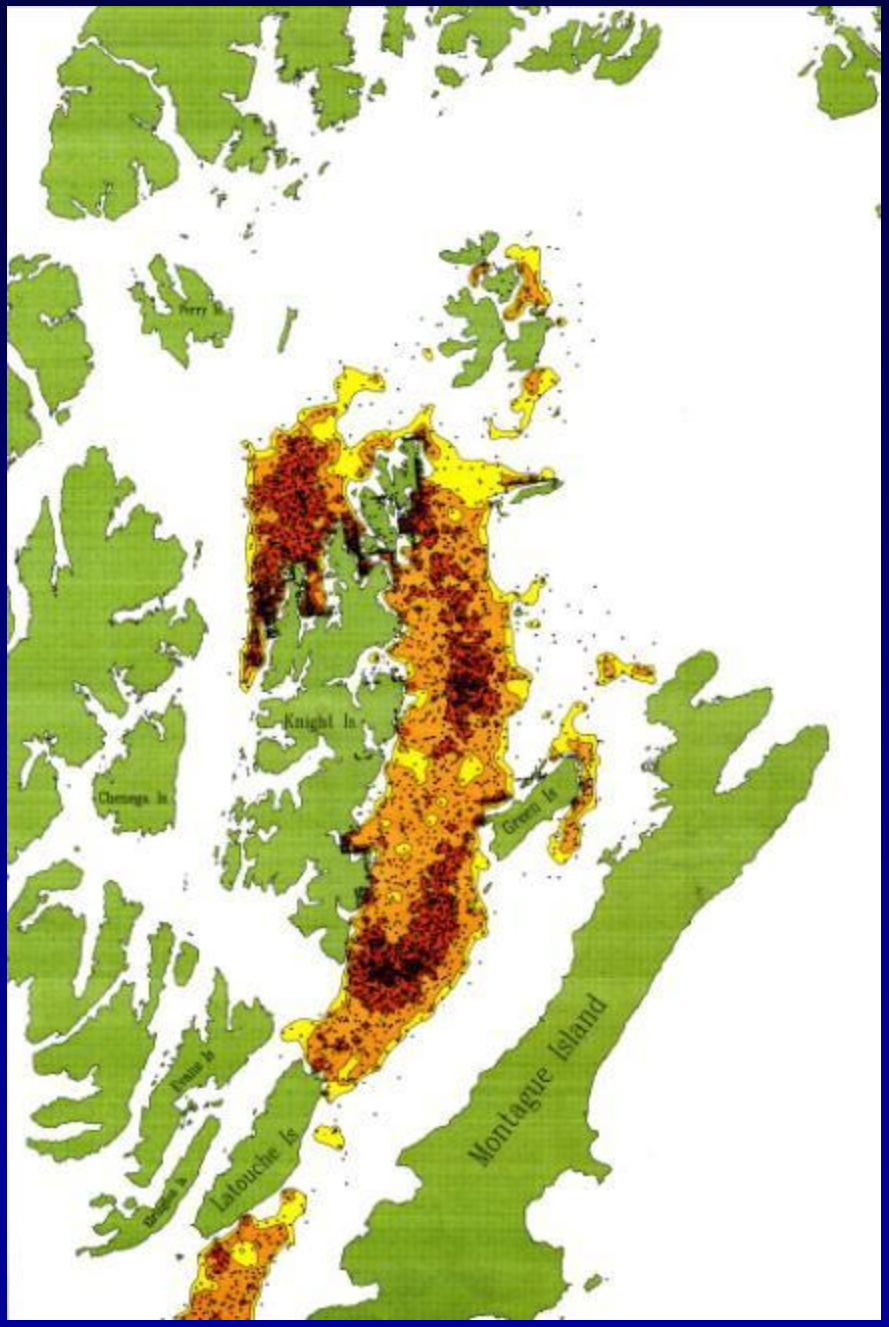
Exxon Valdez Oil Spill

NOAA HAZMAT Trajectory Model

March 30, 1989 **Day Six**

Legend

- 53 particles/sq mile
- 53 to 13 particles/sq mile
- 13 to 3 particles/sq mile
- 3 to 1 particles/sq mile
- Each particle represents ~1,100 gallons of oil (twenty 55 gallon drums)

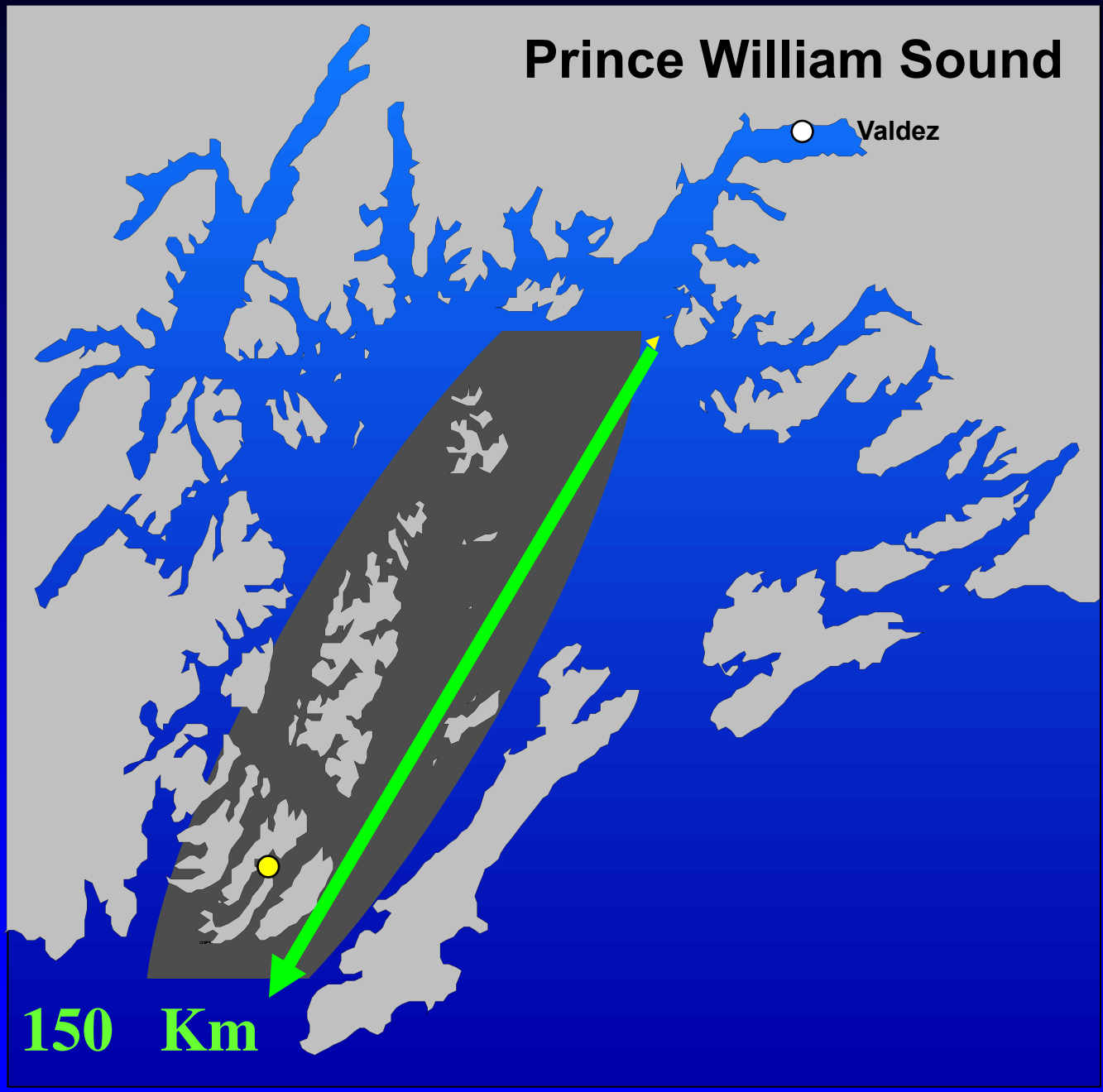


J.A. Galt et al. 1991

Spill Zone After the first week

11 Million gallons

70 Knot winds day 3



Predictable effects

<u>Acute</u> wildlife loss estimates included:

4000 Sea Otters 500,000 Birds

Short Answer: Lots

Second: UN- EXPECTED

5 big wows from the Exxon Valdez spill

Long Term Effects, persistence

1. Long term effects

(Short term exposure)

Killer Whale Story

Killer Whale biology

Long Lived

Low reproductive rates

Organized along Matri-lines

> discrete pods

Two types:

Residents- fish eating

Transients- Marine Mammal eating

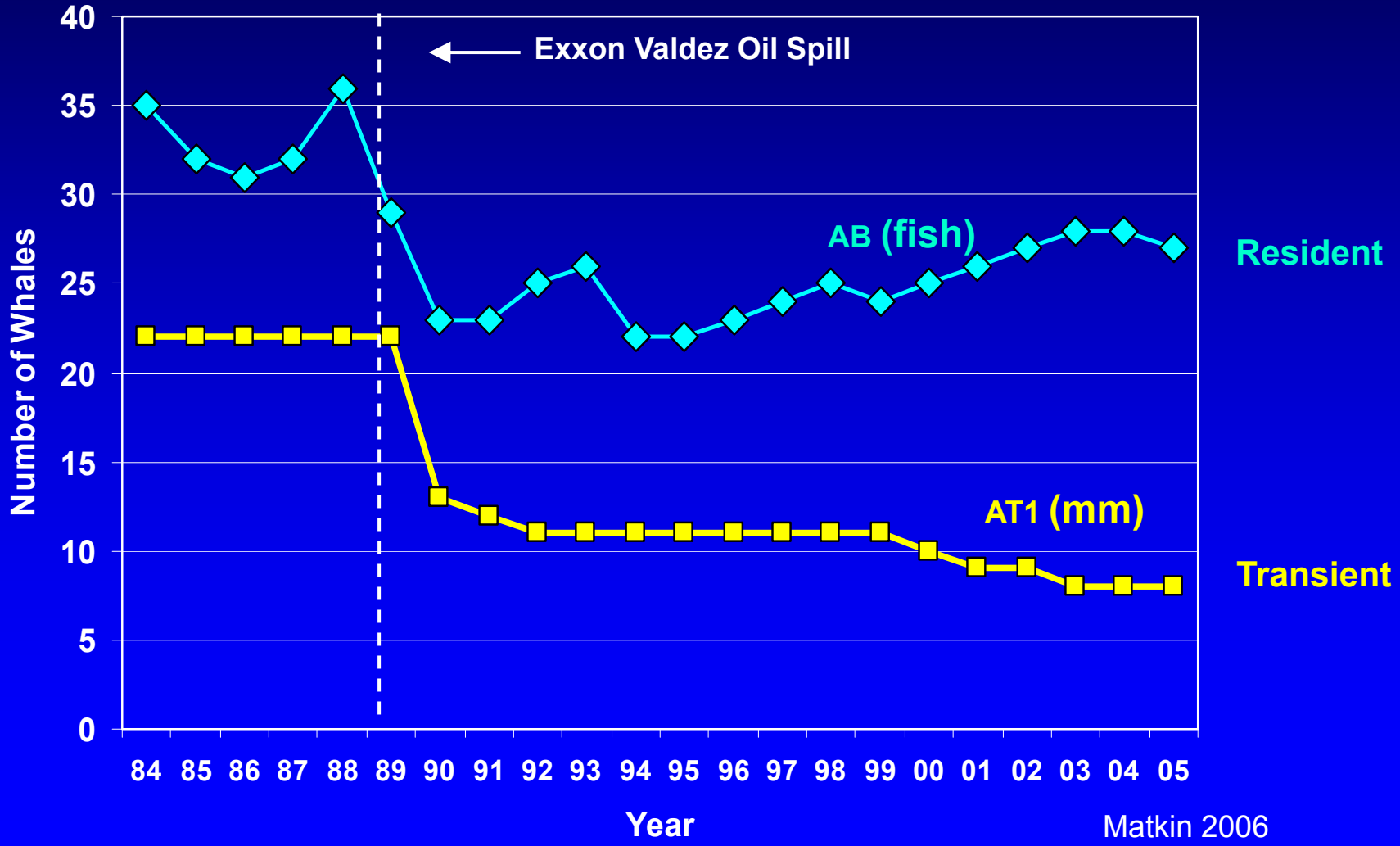
Killer Whale biology

Individuals photo-Identified

since 1984

Two pods photographed in oil slicks
AB and AT1 pods

PWS Orca Survival After the *Exxon Valdez* Oil Spill
Residents / Transients



Matkin 2006

2. Embryos are sensitive- PPB!

Pink Salmon embryos -

1989, plus 4 more years

Surprising,
Perplexing


75% PWS salmon spawn IT


Approximate 1989 conditions

1992-2000:

Lab Tests prove that exposed embryos to low doses will affect Adult returns

Design:

-Long term exposures (Months)

- Low ppb exposures

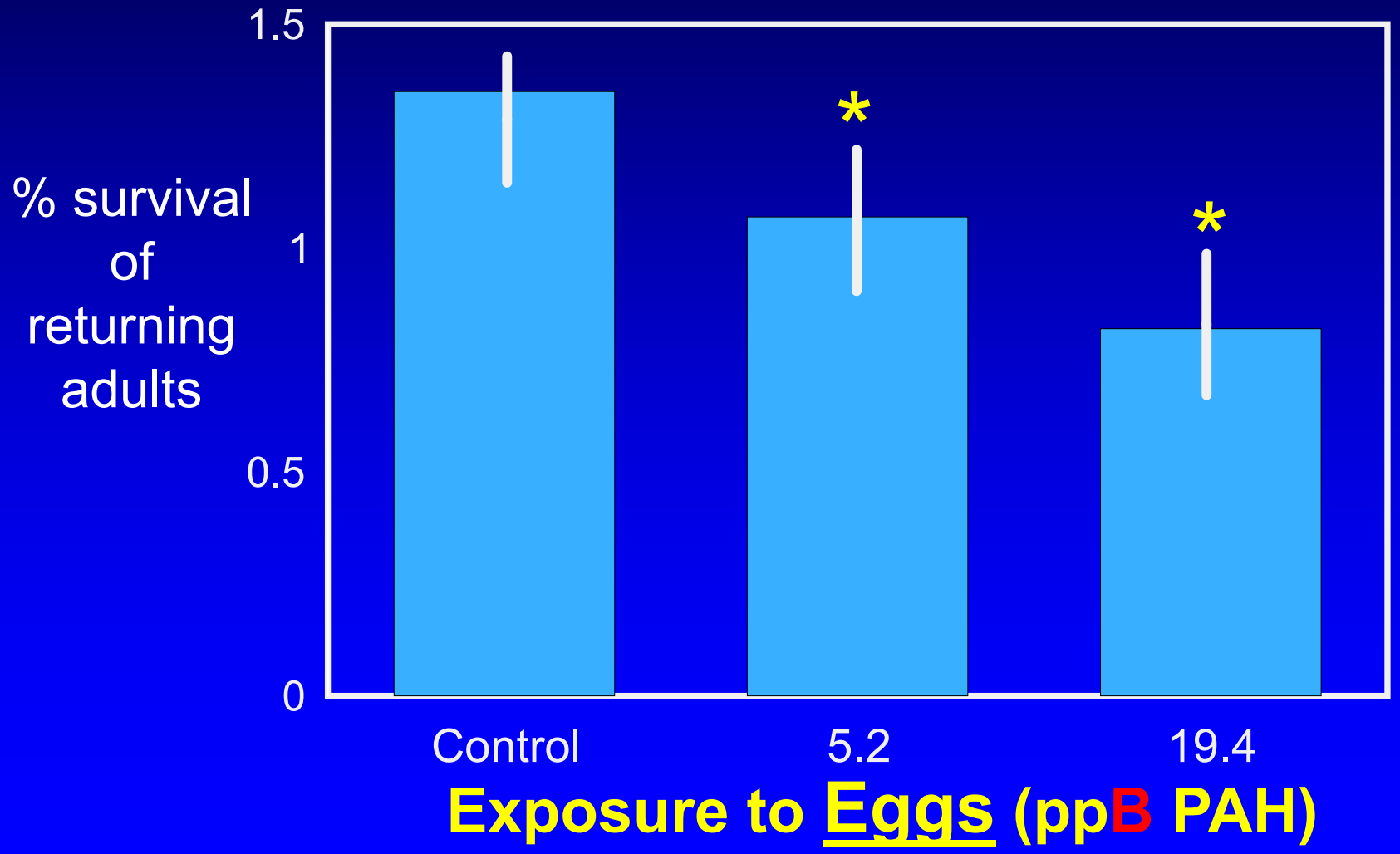
-Released tagged Fry

- Assess when Adults return

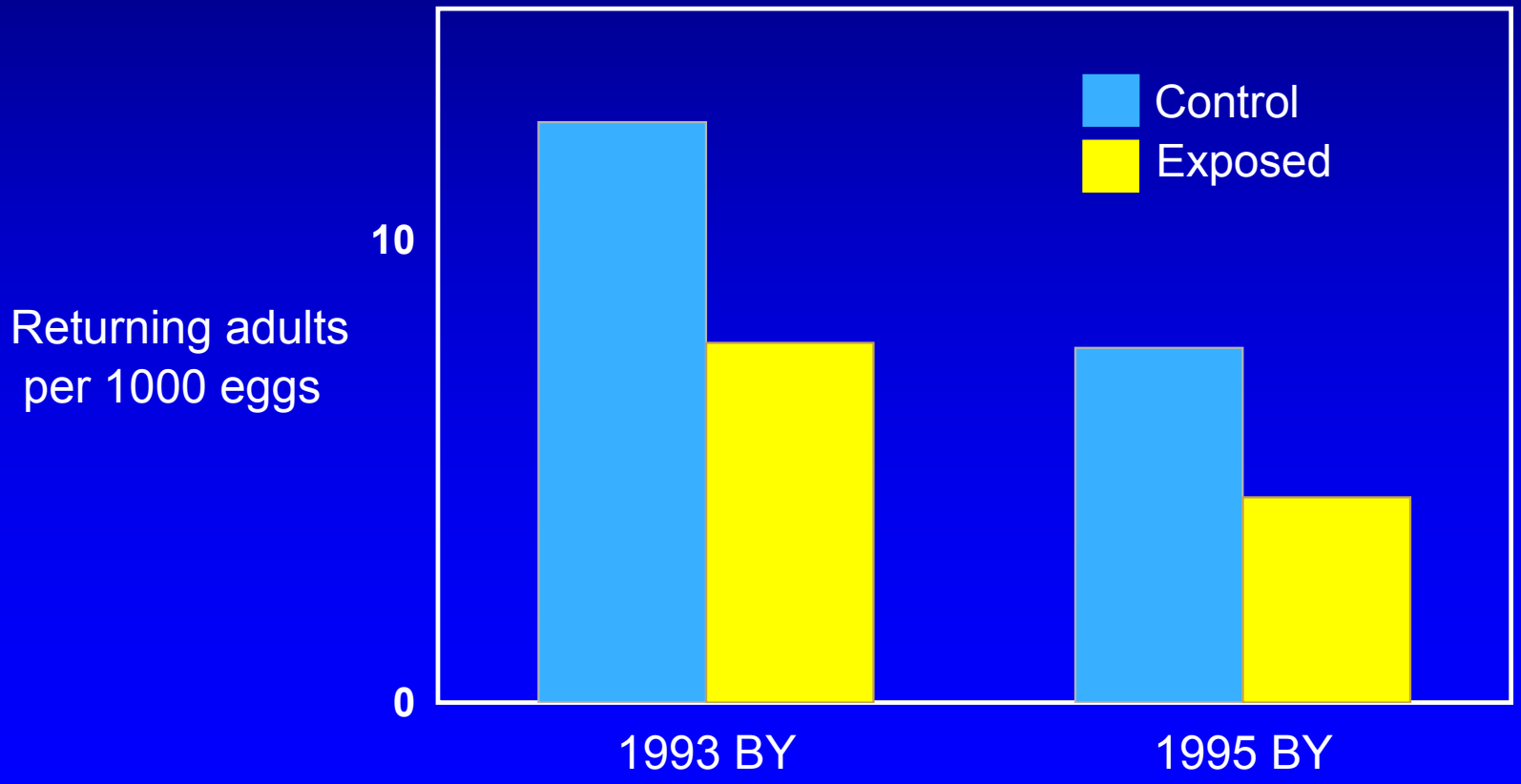
Pink Salmon Eggs

Incubation in Oiled Rocks

Adult Returns Reduced 20% at 5 PPB



Adult returns Reduced (Eggs exposed in 18 ppB)



Pink Salmon Summary

ADFG- 4 year effect in Streams

ABL- Changed toxicity paradigm

Toxicity from ppM to ppB exposures

Fewer Adults return

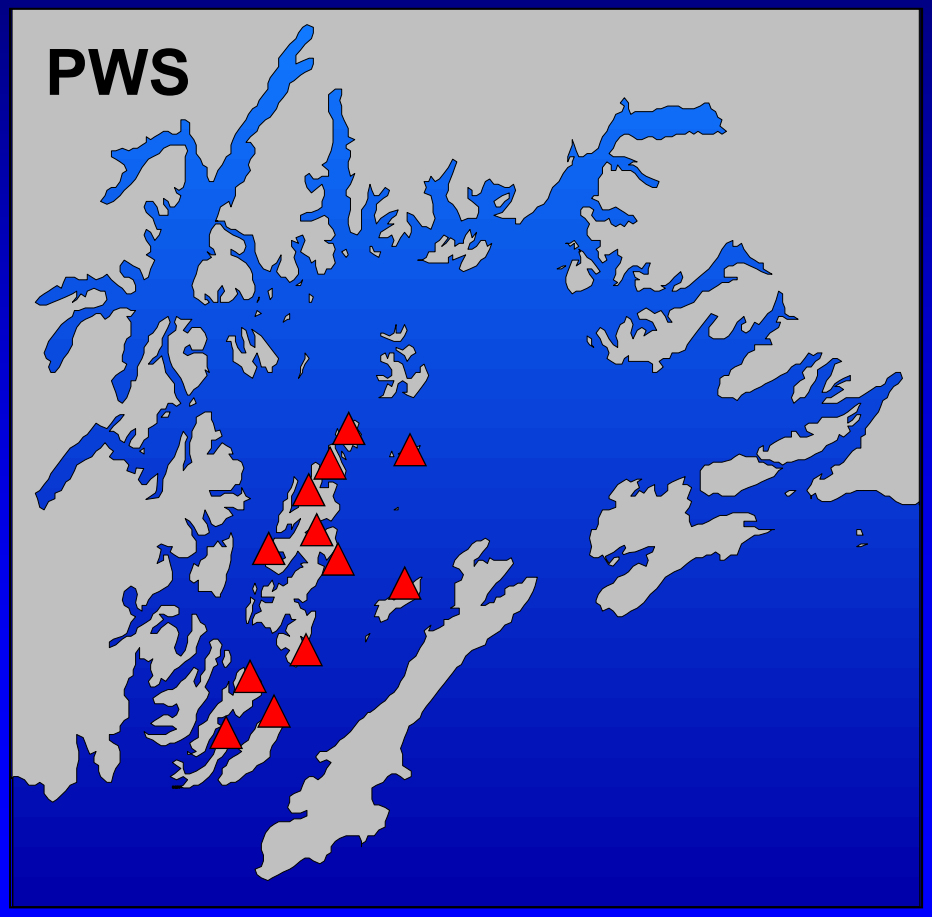
3. Oil persists -

How much?
Where?

1999

Persistence?

2001 Survey: Yes!



91 sites

- 53 sites with oil
- 38 sites without oil

(9000 pits, 1 summer)

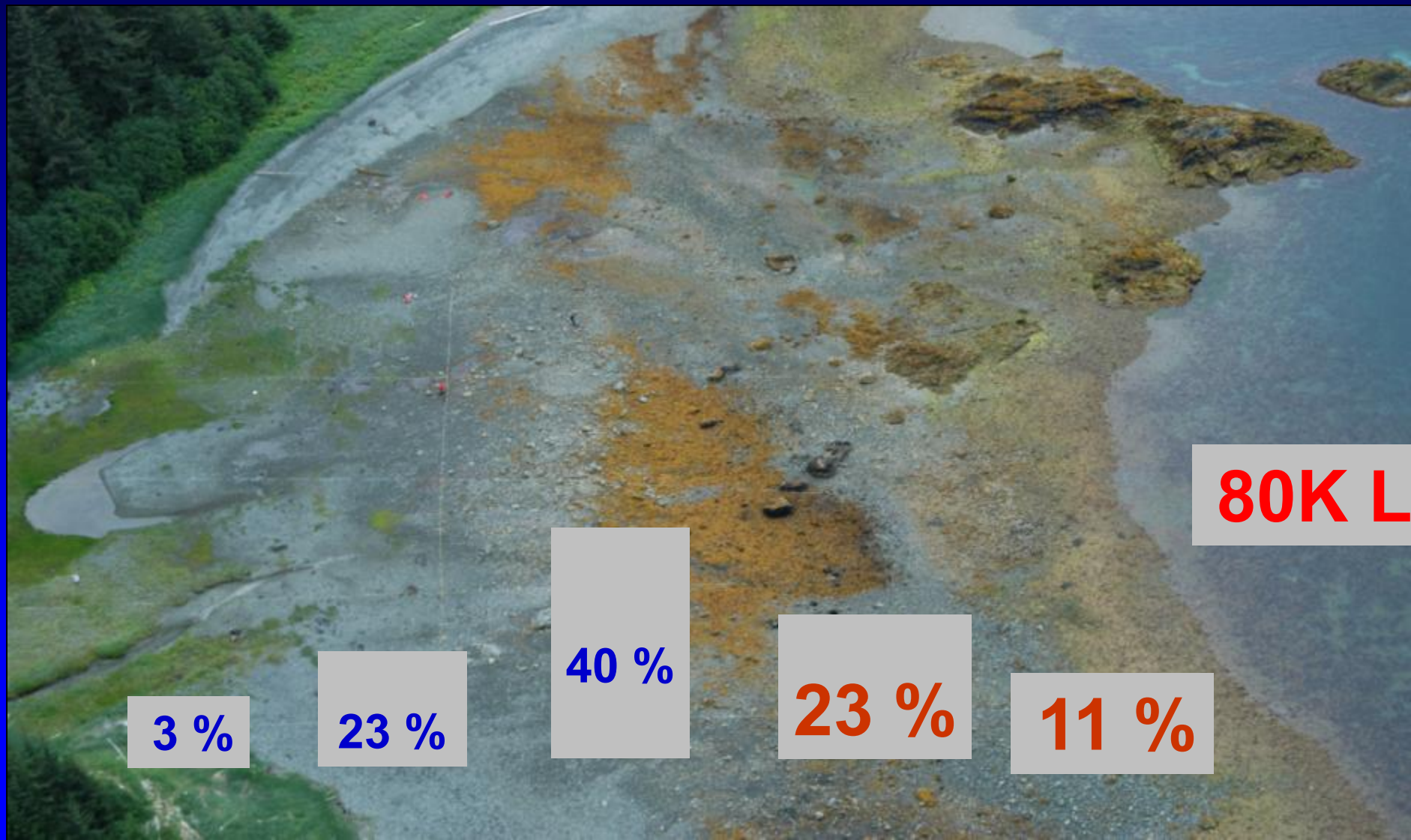
Diggers Working in Boulder Field

2001

Subsurface Oil > Surface

80,000 L estimated

Vertical Distribution of Intertidal Subsurface Oil 2001



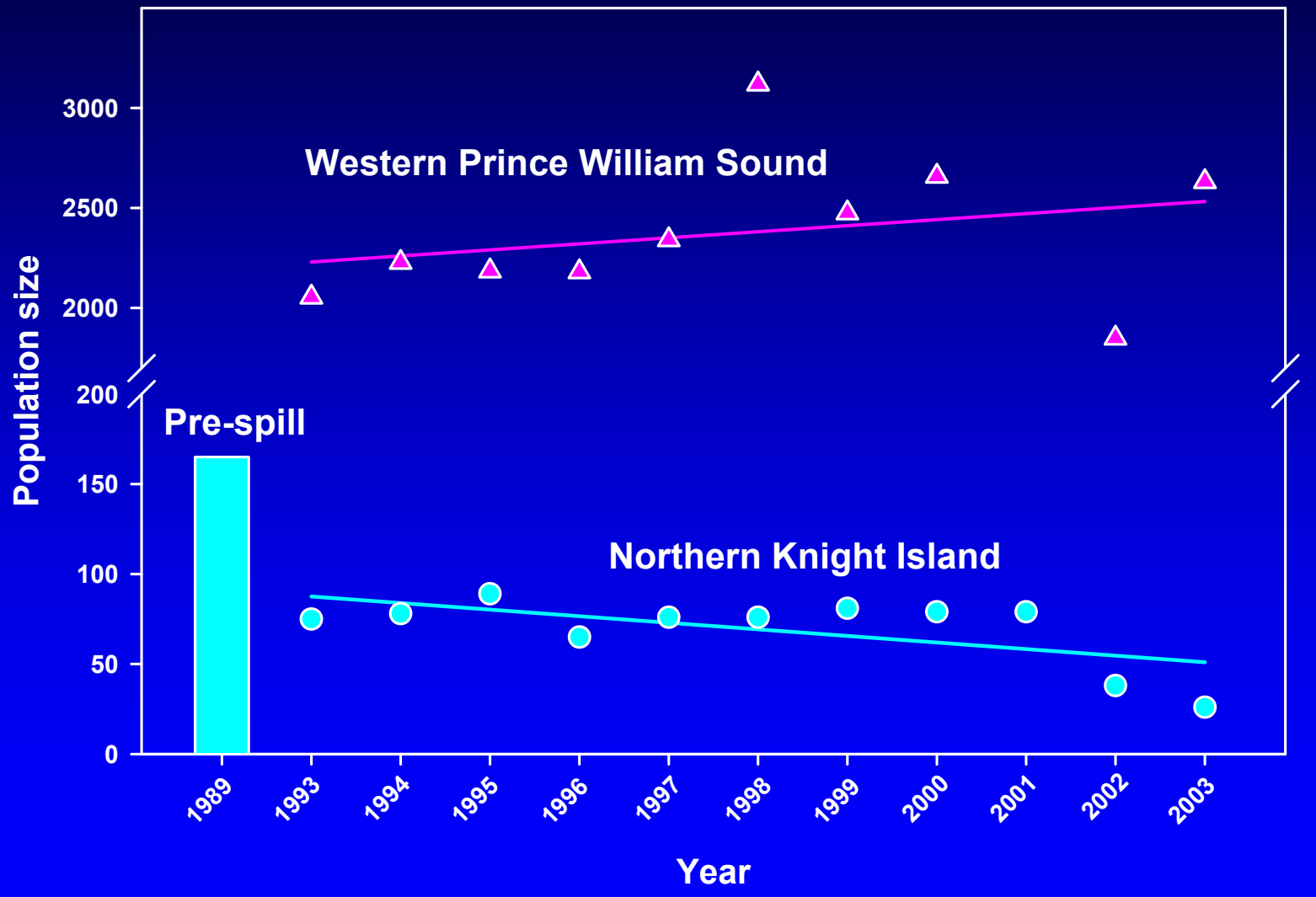
Summary of Oil Persistence

More oil than expected

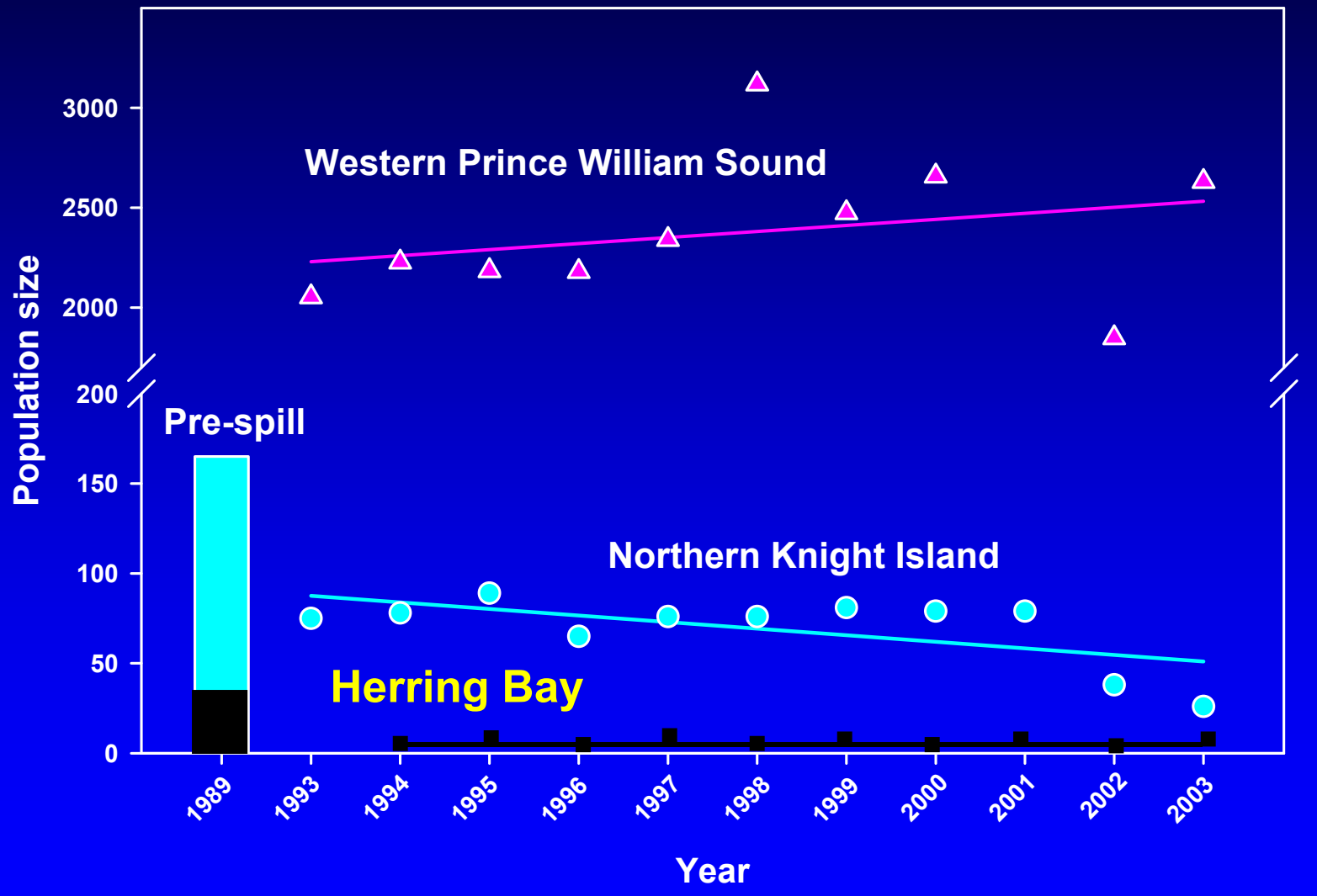
Lots in the lower intertidal zone

4. Lingering oil impacts- Sea Otter Recovery for 20 yrs

Sea Otter Population Trends 1993-2003



Sea Otter Population Trends 1993-2003



Was it food?

Was it oil?

Recovery was Incomplete by Late 1990s

Photo courtesy of R. Davis

Both feed in the lower intertidal

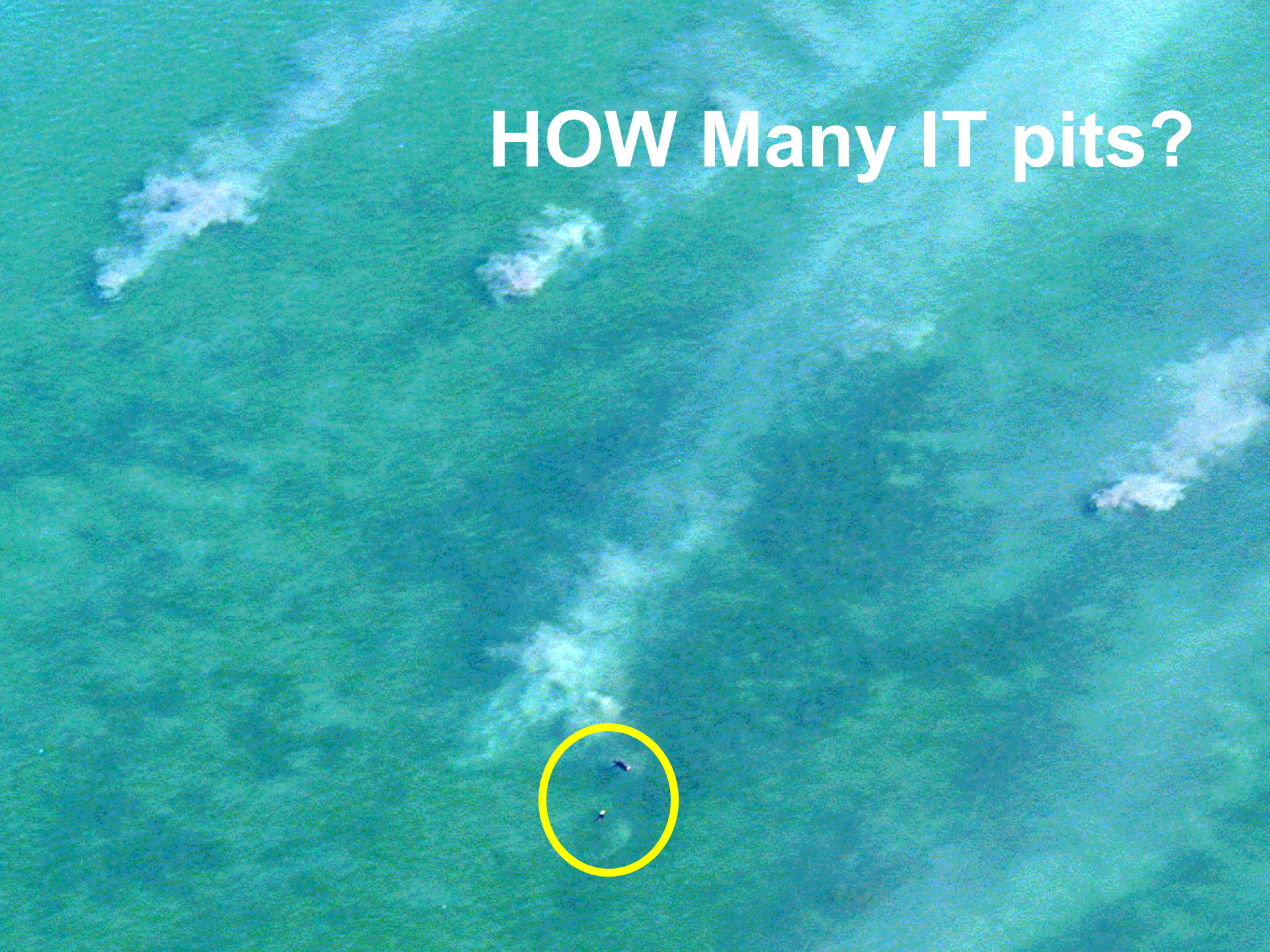
Both
Need to eat
A lot
(winter)

- **25 %**

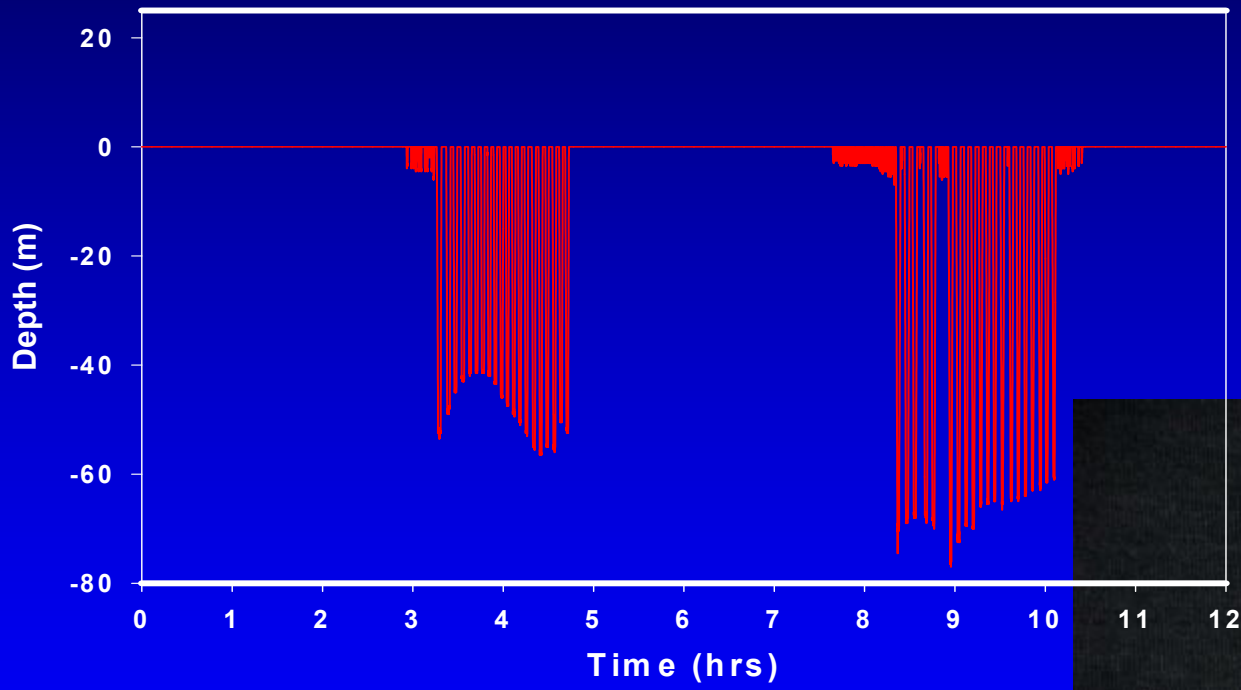
Body Wt
Per day

Photo courtesy of R. Davis

HOW Many IT pits?

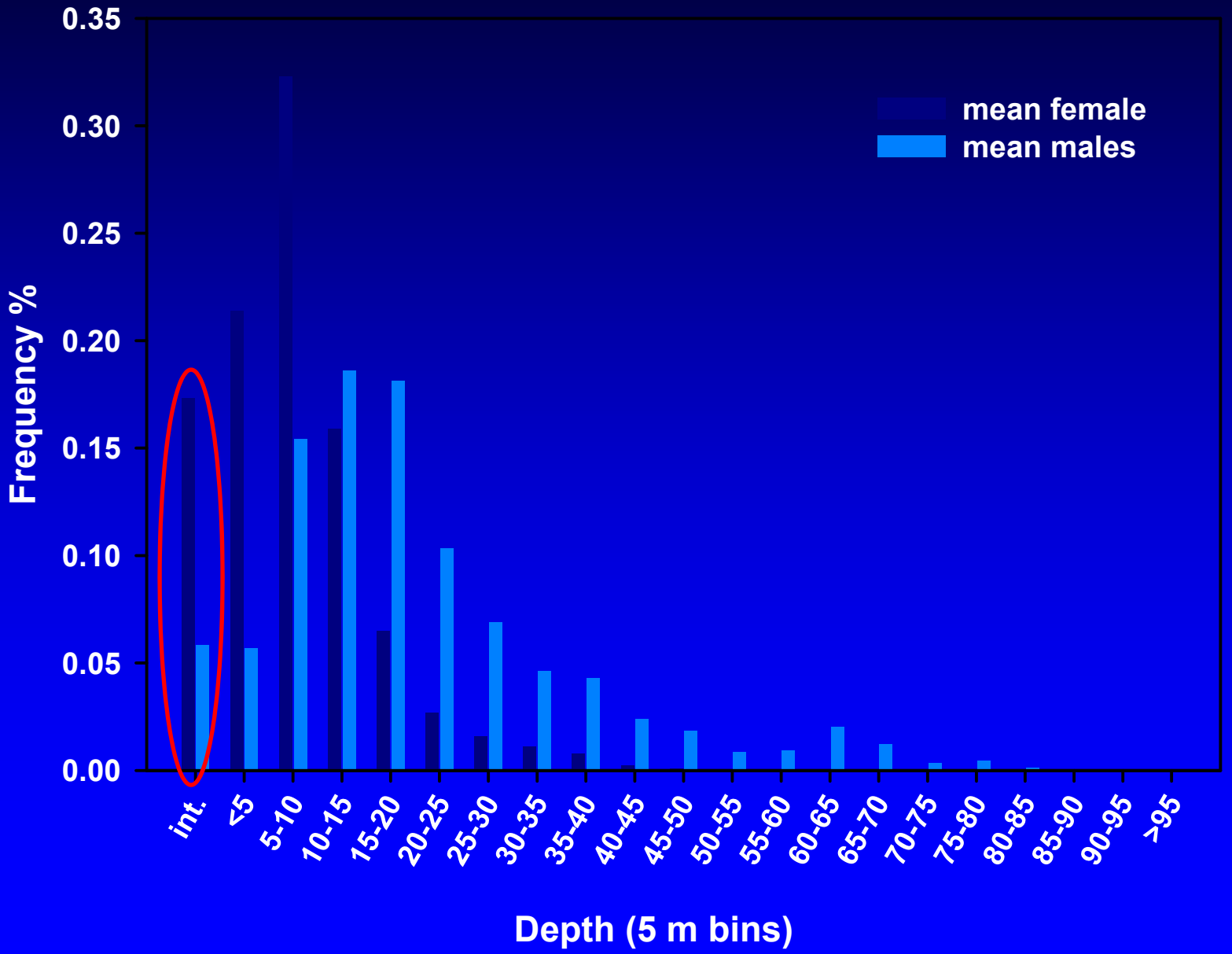


Time Depth Recorder Implants to Estimate Extent of Intertidal Foraging



Shallow dives for Mothers with pups

Forage dive depth distributions
12 females and 4 males PWS 2003-2005



How many intertidal pits do they dig?

2003-2005 data, n=16

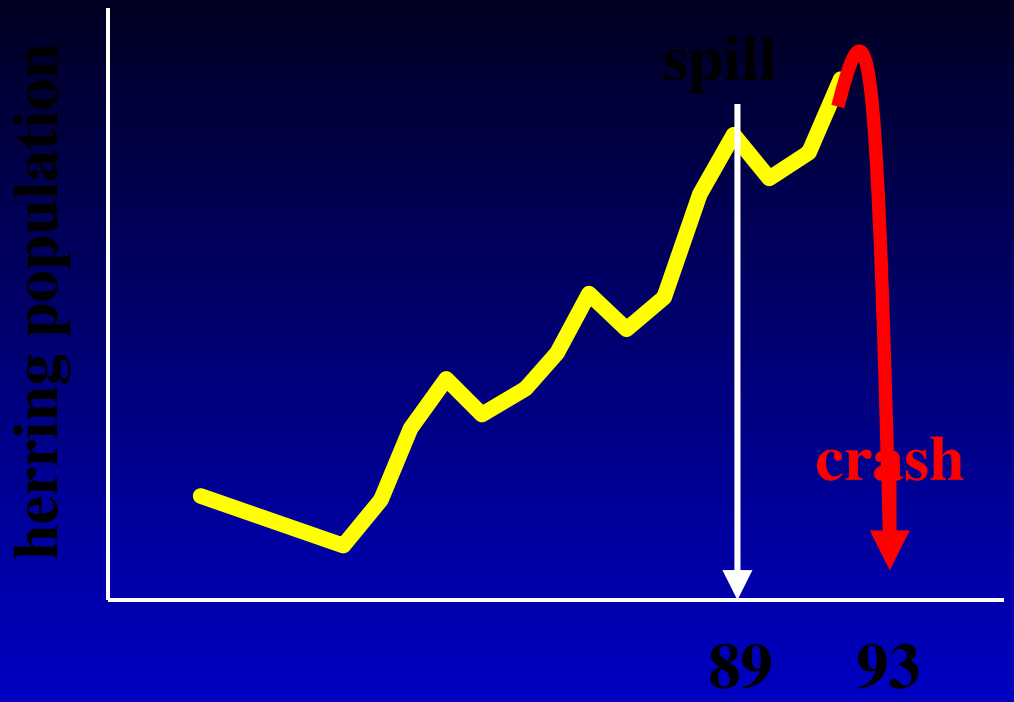
at N Knight Island

- **65 Otters dig about 200,000 pits / yr**
- **4 million pits over 20 years**

5. Watch out for the ecosystem surprises!

Pacific Herring of PWS continue to struggle in 2007

PWS Herring



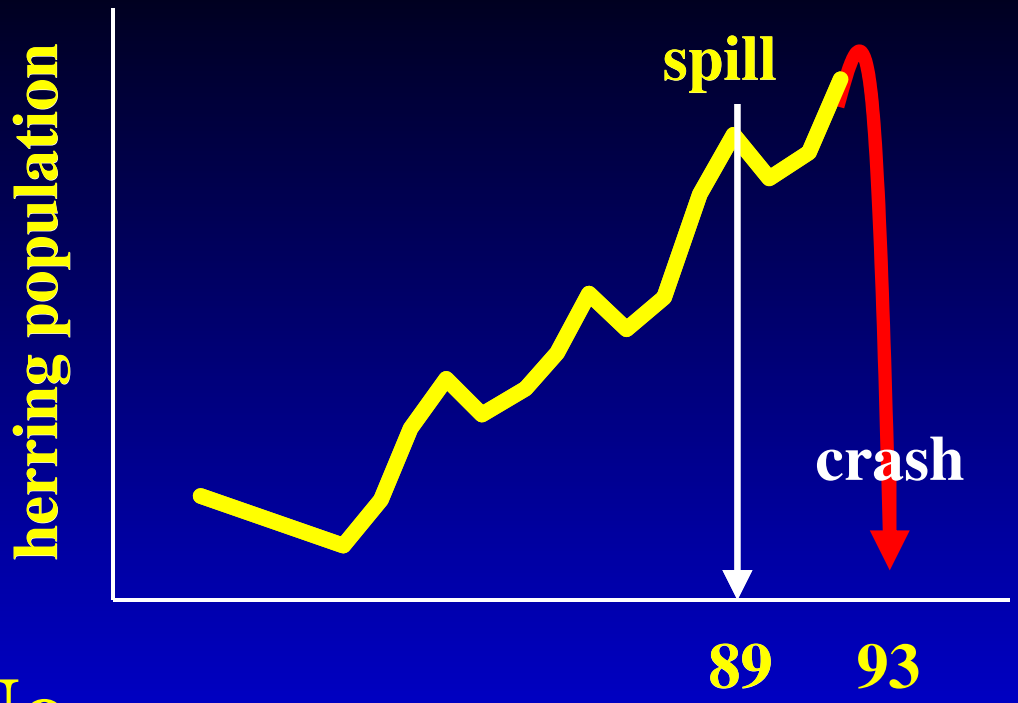
Short Term Impacts

- yes- 1989 yr class missing
  but did Not affect population

Long Term Impacts

- Huge crash; related to oil?

1993: Was it Oil?



Direct Oil? = No

Indirect Oil ? Possible?

(no where else in AK has there been a crash)

Big Problem

- Recovery continues to be poor

Lack of Recovery- Why?