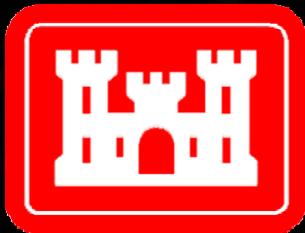


SEA LION DETERRENTS AT BONNEVILLE DAM: DID THEY WORK?

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Objectives

- Estimate number of adult salmonids and other fish caught
- Record seasonal timing, abundance of sea lions
- Record sea lion behavior, individual habits
- Test measures used to deter sea lion presence and predation on salmon

Observations

- Surface observations during daylight hours
 - One observer per tailrace (PH1, PH2, spillway)
 - Record catches and losses of fish
 - Identify individual sea lions
 - Estimate number of sea lions present at each tailrace
- Randomized, paired-treatment, 4-day (2 days on/off) block design to test effectiveness of hazing and acoustics combination

SLEDs

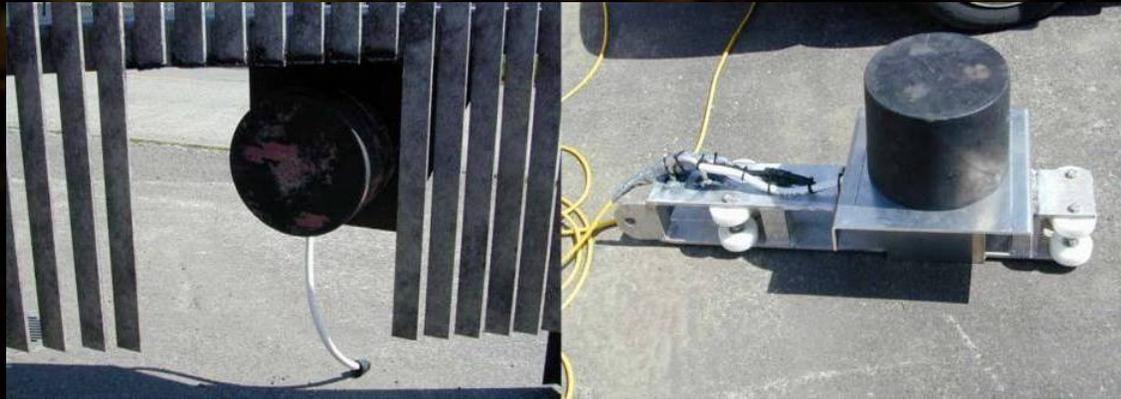
- Sea lion exclusion devices (SLEDs) installed at fishway entrances
- 12 entrances, 2 sections each, 15 3/8" gaps
- Designed to allow salmon passage



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Acoustic Deterrent Devices (ADD)

- 205 decibel, 15 kHz frequency acoustic projectors installed at fishway entrances (March – May 2006)
- Advertised “painful” effective range of 30 ft., and potential effects up to 100 ft.
- ADDs turned on at 0500 hrs on hazing days, turned off at 2000 hrs at the end of each 2-day treatment
- No significant effects on salmon passage



USDA Hazing

- March – May 2006
- USDA APHIS Wildlife Services agents armed with cracker shells, rubber bullets, and screamer shells
- Opportunistically hazed sea lions hauled out and those within 100 ft. of fishways
- Identified hazed sea lions when possible



Boat-based Hazing

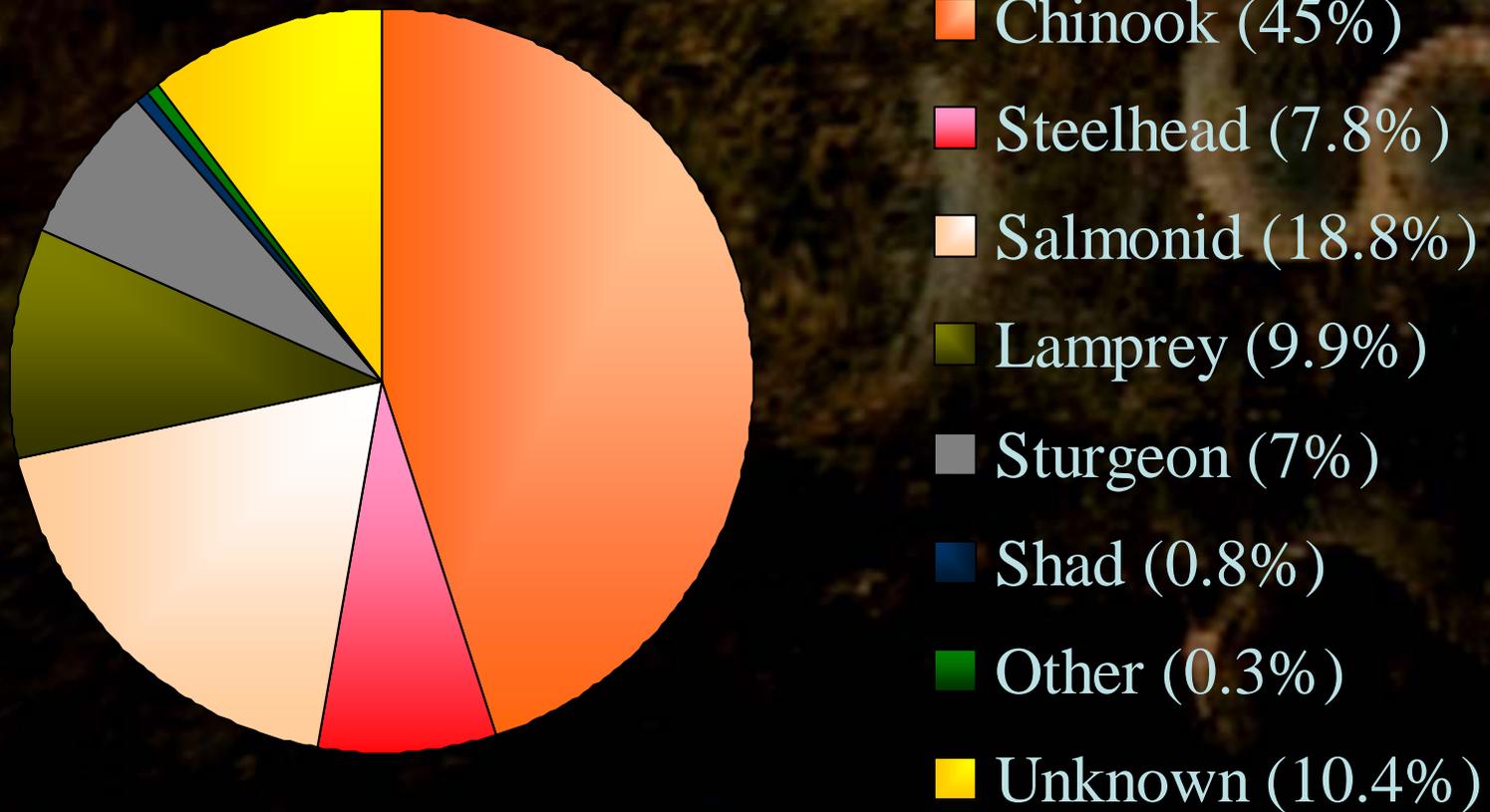
- State, federal, and tribal personnel armed with non-lethal hazing pyrotechnics and rubber bullets
- Hazed sea lions in all tailraces to chase them downstream of the dam
- Alternating (non-randomized) 4-day on/off blocks



The background is a dark, almost black, textured surface. It features several faint, glowing, circular or ring-like patterns that appear to be part of a larger, complex structure, possibly a biological specimen like a cross-section of a tree trunk or a geological formation. The lighting is low, creating a moody and mysterious atmosphere.

RESULTS

Observed catches by pinnipeds at Bonneville Dam tailrace (2006)

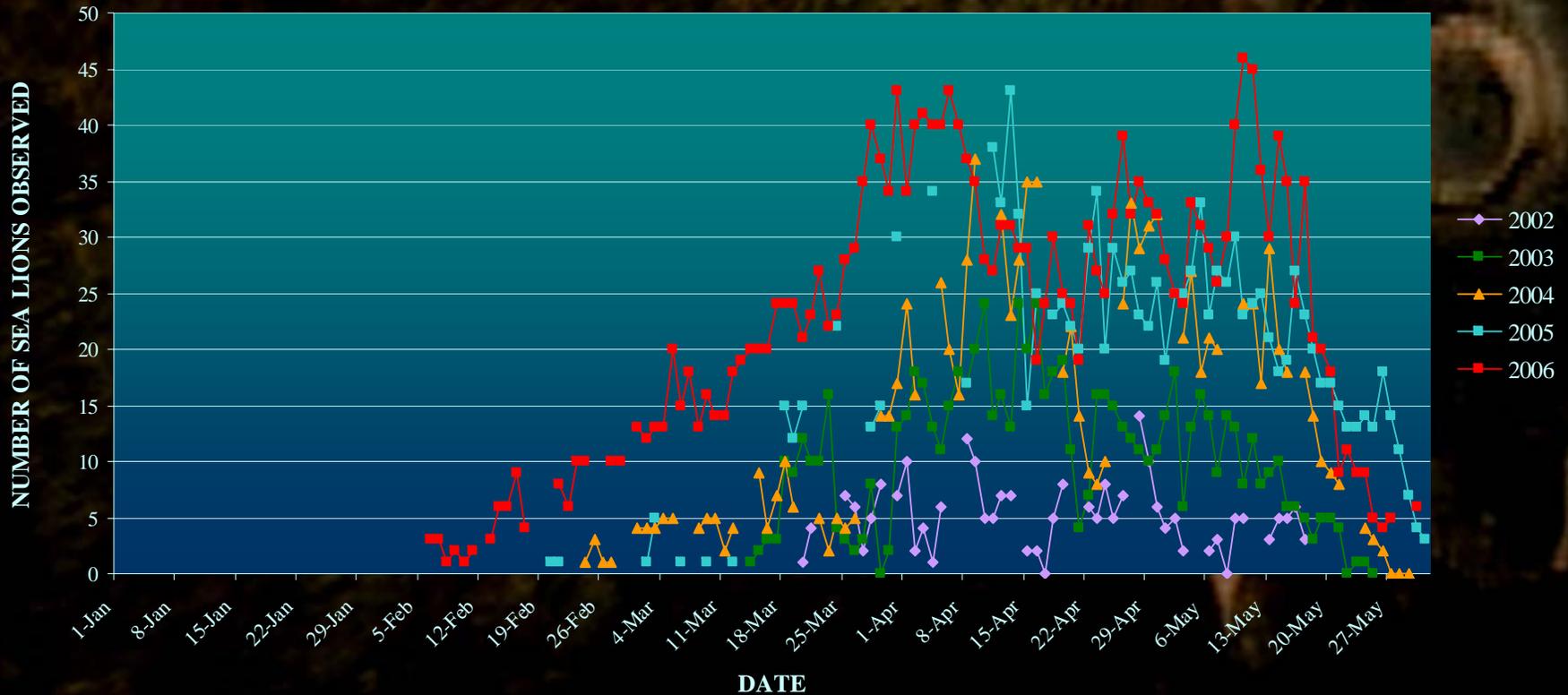




Estimated salmonid catch by sea lions at Bonneville Dam, 1 January – 31 May

| Year | Estimate of Salmonids Caught | Total Salmonid Passage at Bonneville | % of Salmonid Run Taken by Sea Lions |
|------|------------------------------|--------------------------------------|--------------------------------------|
| 2002 | 1,010 | 284,733 | 0.4% |
| 2003 | 2,329 | 217,185 | 1.1% |
| 2004 | 3,533 | 186,804 | 1.9% |
| 2005 | 2,920+ | 82,006 | 3.4%+ |
| 2006 | 3,023 | 105,063 | 2.8% |

Seasonal distribution of sea lions at Bonneville Dam, 2002-2006



Estimated pinniped abundance at Bonneville Dam, 2002-2006

| | 2002 | 2003 | 2004 | 2005 | 2006 |
|-------------------------|-----------|------------|------------|------------|-----------|
| California Sea Lions | 30 | 106 | 101 | 80+ | 72 |
| Steller's Sea Lions | 0 | 3 | 2 | 4 | 10 |
| Harbor Seals | 1 | 2 | 2 | 1 | 3 |
| TOTAL | 31 | 111 | 105 | 85+ | 85 |

SLEDs

- Infamous C404 passed through SLEDs early
- No other sea lions entered the fishways
- Late arrival of Spring Chinook prompted concerns about potential impact of SLEDs on fish passage
- No significant effect on salmon passage



Acoustics: The Short Story

- No obvious effect on behavior of sea lions within 100 ft. of fishway entrances
- Turbulence near fishway entrances likely reduced effective range of ADDs
- Cannot separate results from hazing because of paired treatment design
- “...combined effects of hazing and ADDs did not impede the passage of radio-tagged adult spring Chinook salmon during 2006.” (Jepson et al. 2006)

Hazing: The Short Story

- Rubber bullets were used in 55% of hazing events, cracker shells in 40% of events
- 81% of hazing events involved animals near fishways, 16% of events involved hauled out animals
- Peak hazing activity was in early morning and late afternoon, coinciding with haul out and predation patterns
- Only 7 individuals were hazed more than 5 times
- Maximum number of times an animal was hazed was 21 (C309)

Hazing: The Short Story

- One USDA agent per shift seemed inadequate relative to predation levels
- Most predation (84%) occurred outside 100 ft. of fishway entrances
- Hazing sea lions off haul outs *may* increase predation activity (maybe, maybe!)
- Branded sea lions were easiest to identify, and were likely disproportionately represented in hazing tallies
- Hazed sea lions would temporarily leave, then resume activities

USDA Hazing and Acoustics

| | ON | OFF | Paired t |
|--|-------|--------|----------|
| Total project salmonid take | 1,488 | 1,177 | 0.02 |
| Avg. daily pinniped presence | 26.8 | 27.1 | 0.40 |
| Salmonid take w/in 100' of entrances | 202 | 232 | 0.22 |
| Total pinniped activity w/in 100' of entrances | 9,098 | 12,819 | 0.002 |

Boat Hazing

ON

OFF

Paired t

| | | | |
|--|-------|-------|------|
| Total project salmonid take | 1,147 | 1,241 | 0.33 |
| Avg. daily pinniped presence | 29.3 | 27.3 | 0.24 |
| Salmonid take w/in 100' of entrances | 183 | 186 | 0.47 |
| Total pinniped activity w/in 100' of entrances | 8,870 | 7,623 | 0.17 |



SUMMARY

Summary

- ~ 3,023 salmonids (2.8% of run) taken at Bonneville
- California and Steller's sea lions coming earlier, staying longer
- SLEDs seemed to work, didn't impede salmon
- Limited hazing/acoustic deterrence efforts failed to reduce predation on salmonids
- Hazing/ADD combination did not impede salmon passage

2007 Season

- Continue full-time daylight observations
- Start partial observations in January
- SLEDs to be installed by February
- ADDs will be activated in February
- Possibly more intensive and deliberate hazing to occur, dawn to dusk, 7 days/week, February thru May
- Possibly some trapping and branding
- Unlikely any lethal take to be conducted

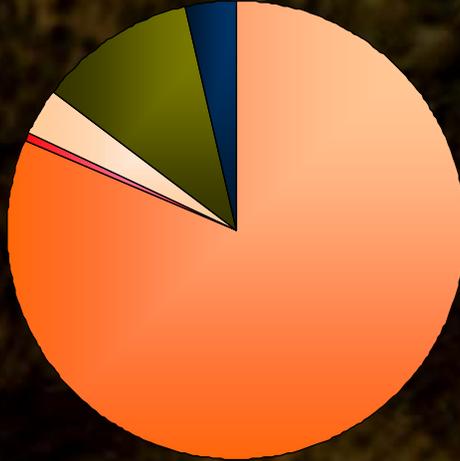
Contributors and Partners

- NOAA Fisheries
- USGS
- USDA APHIS Wildlife Services
- Columbia River Treaty Indian Tribes
- University of Idaho
- Oregon Department of Fish and Wildlife
- Washington Department of Fish and Wildlife

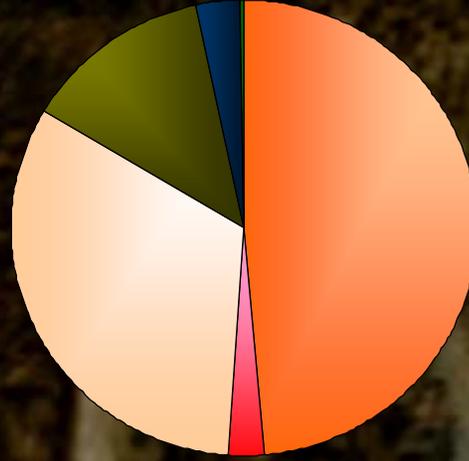


*Mmmm...
I could go
for some
salmon.*

2003

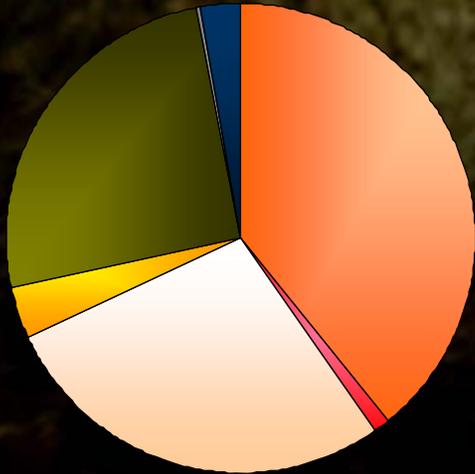


2004

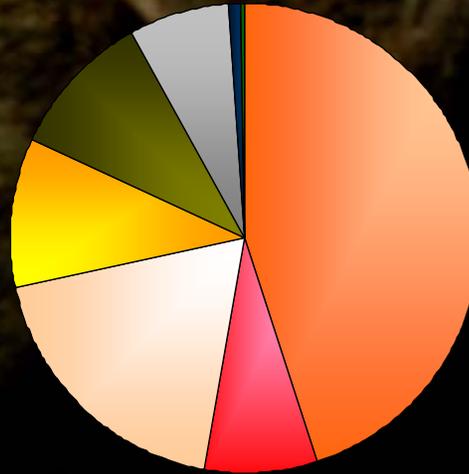


- Chinook Salmon
- Steelhead
- Salmonid
- Lamprey
- Sturgeon
- Shad
- Unknown
- Other

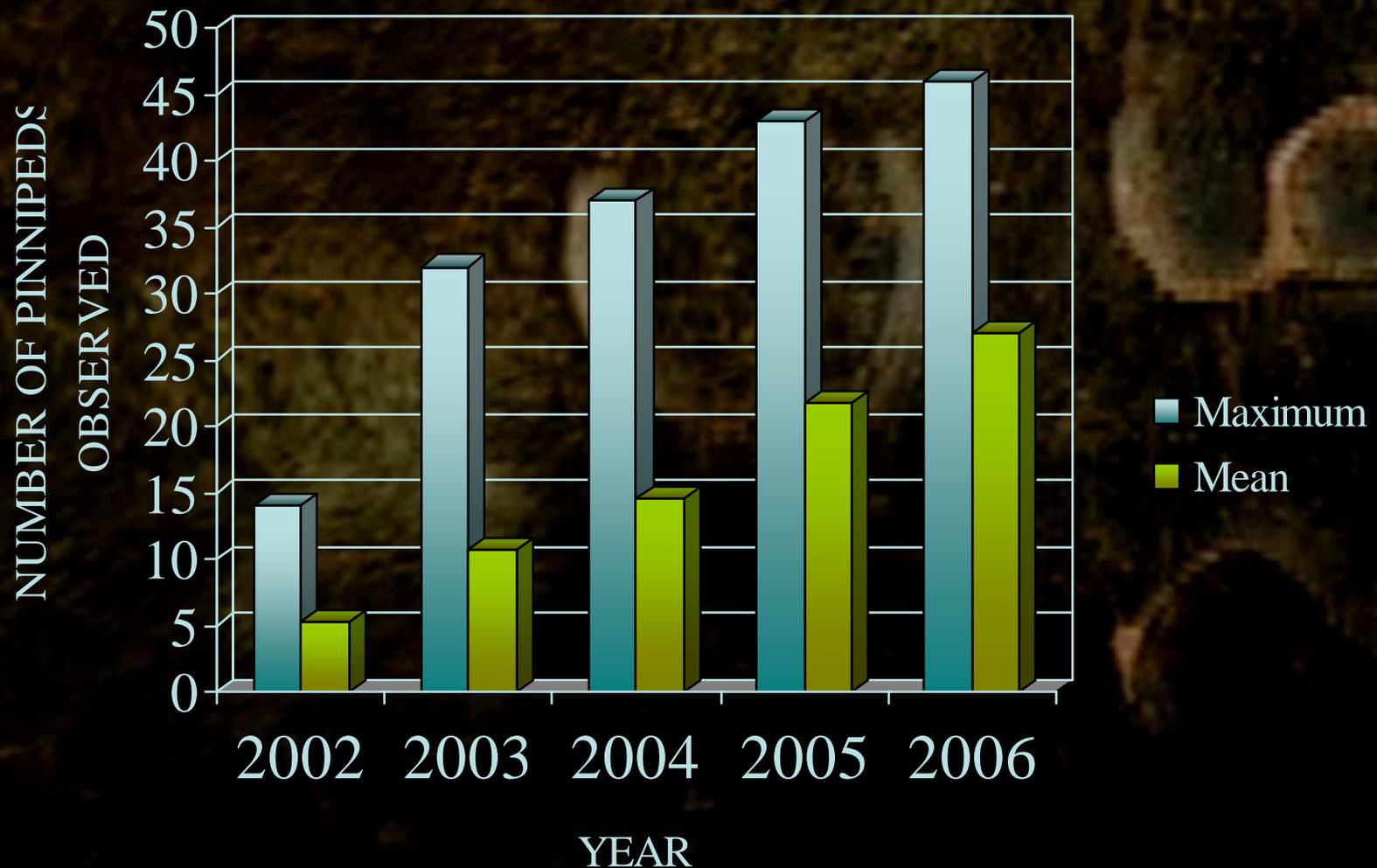
2005



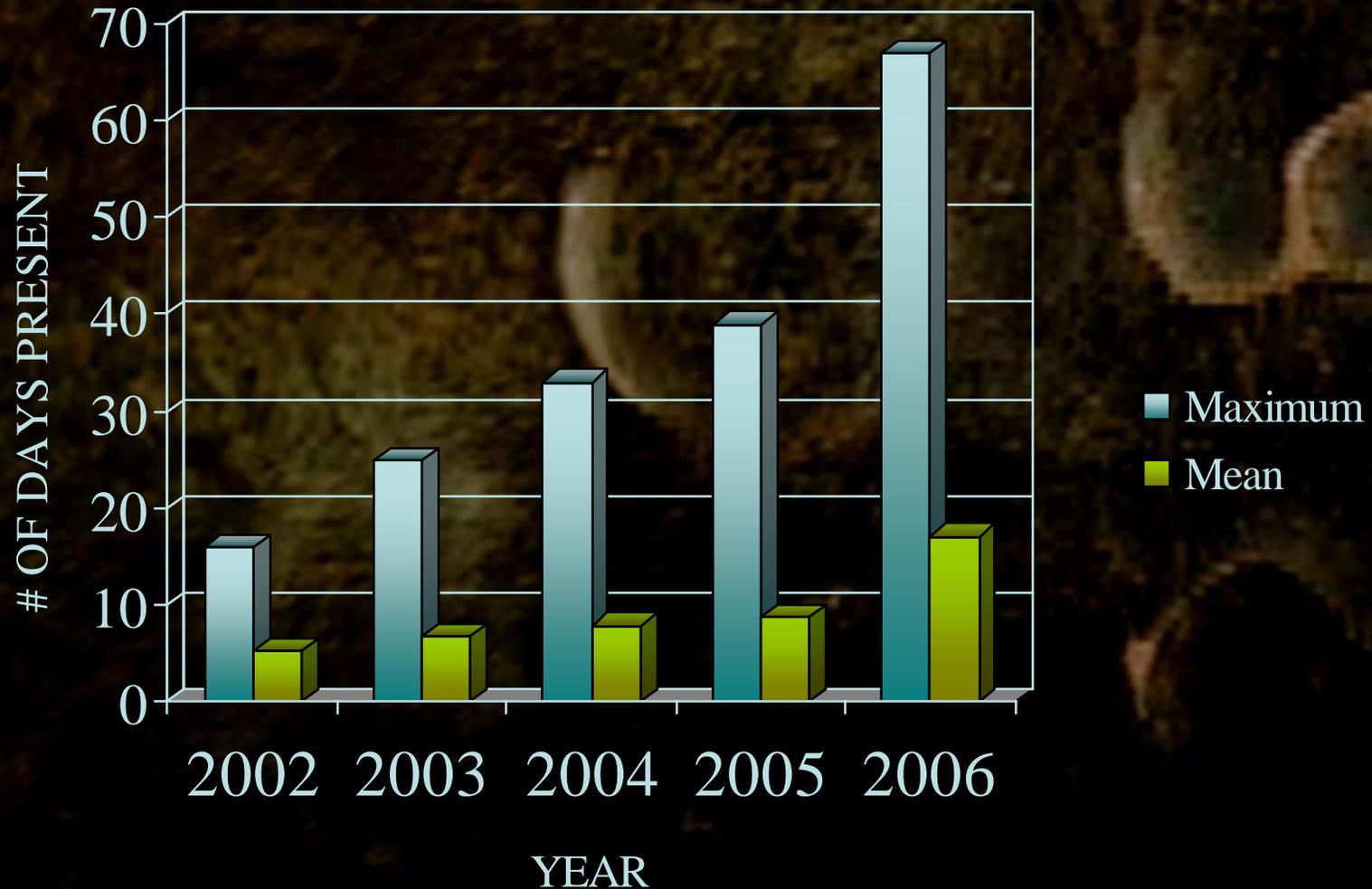
2006



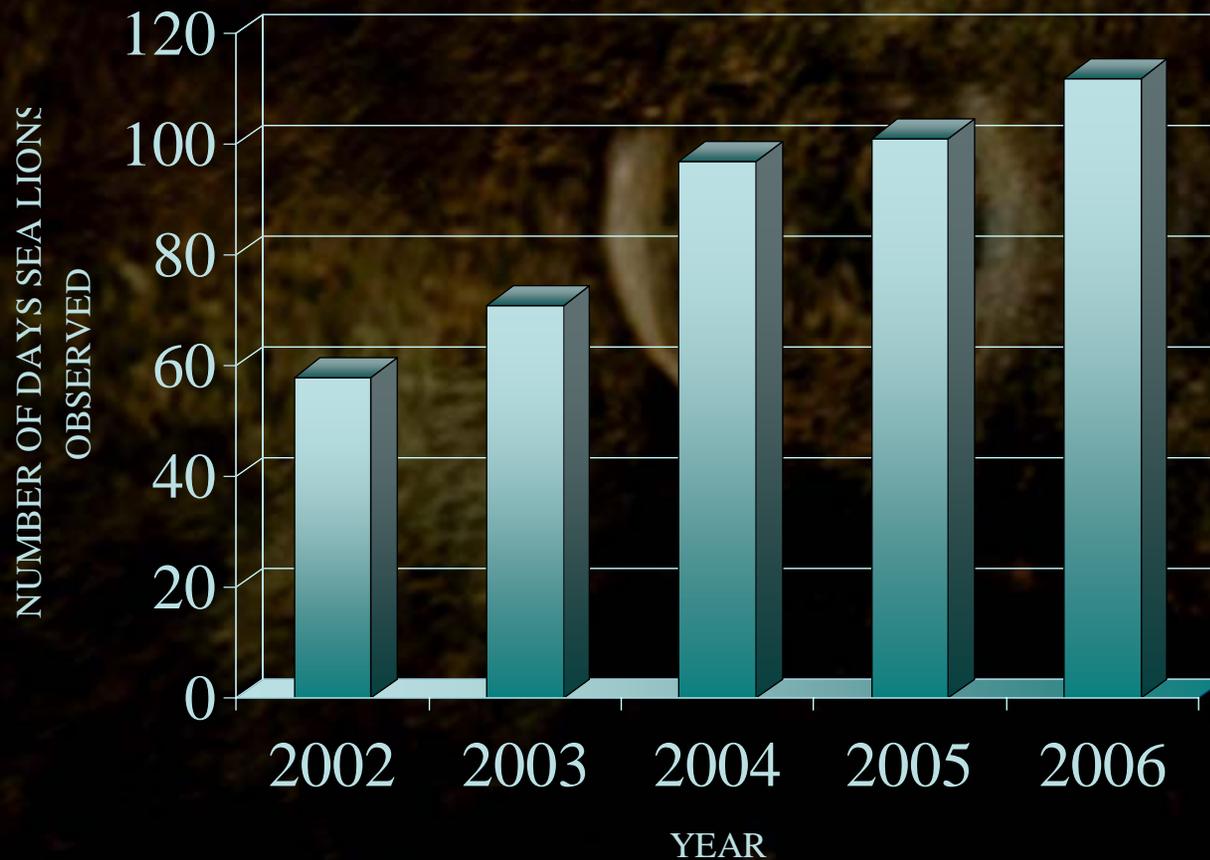
Daily maximum and mean # of pinnipeds observed at Bonneville Dam, 2002-2006



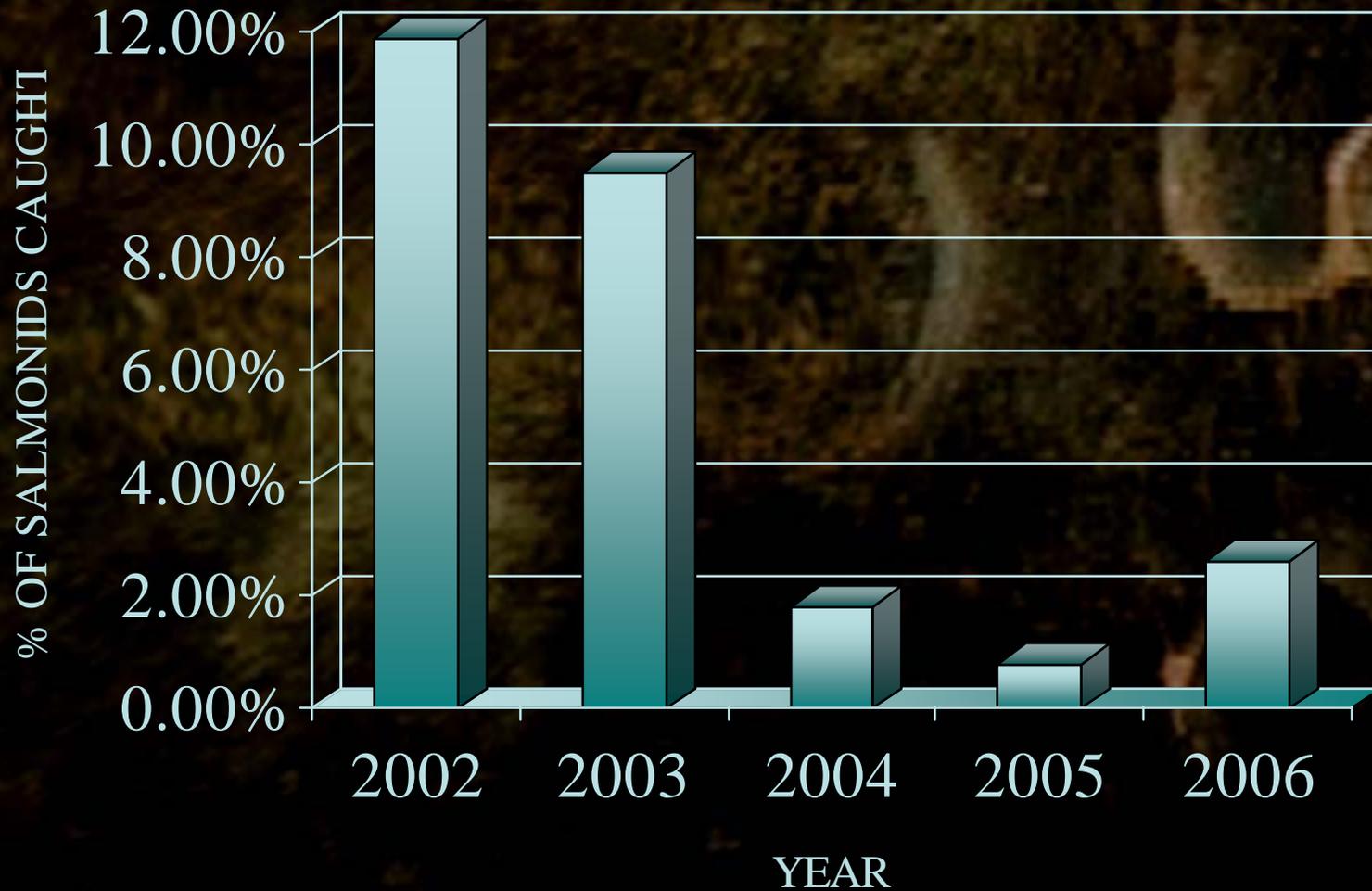
Number of days individual sea lions present, 1 January – 31 May



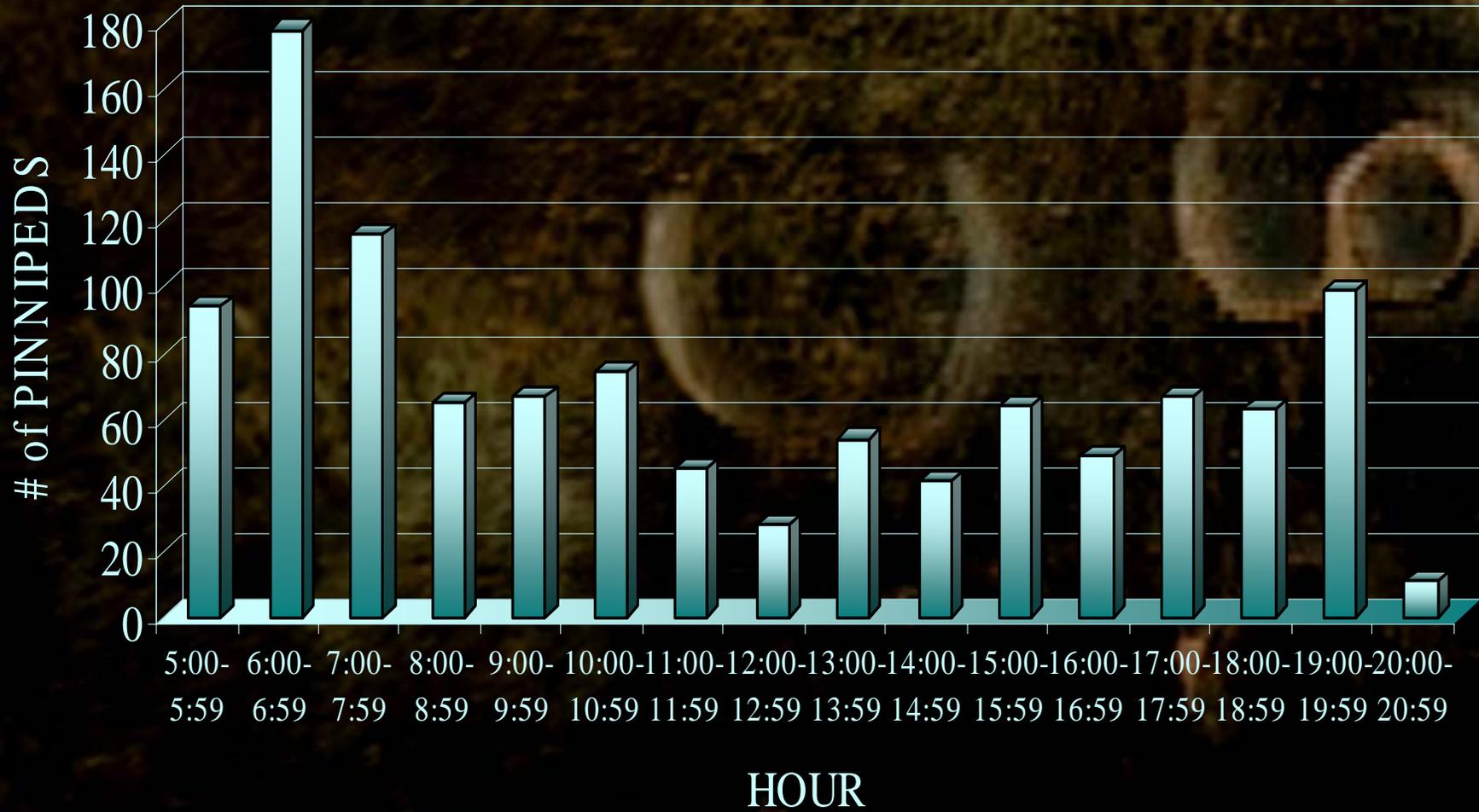
Number of days sea lions observed between 1 January and 31 May, at Bonneville Dam



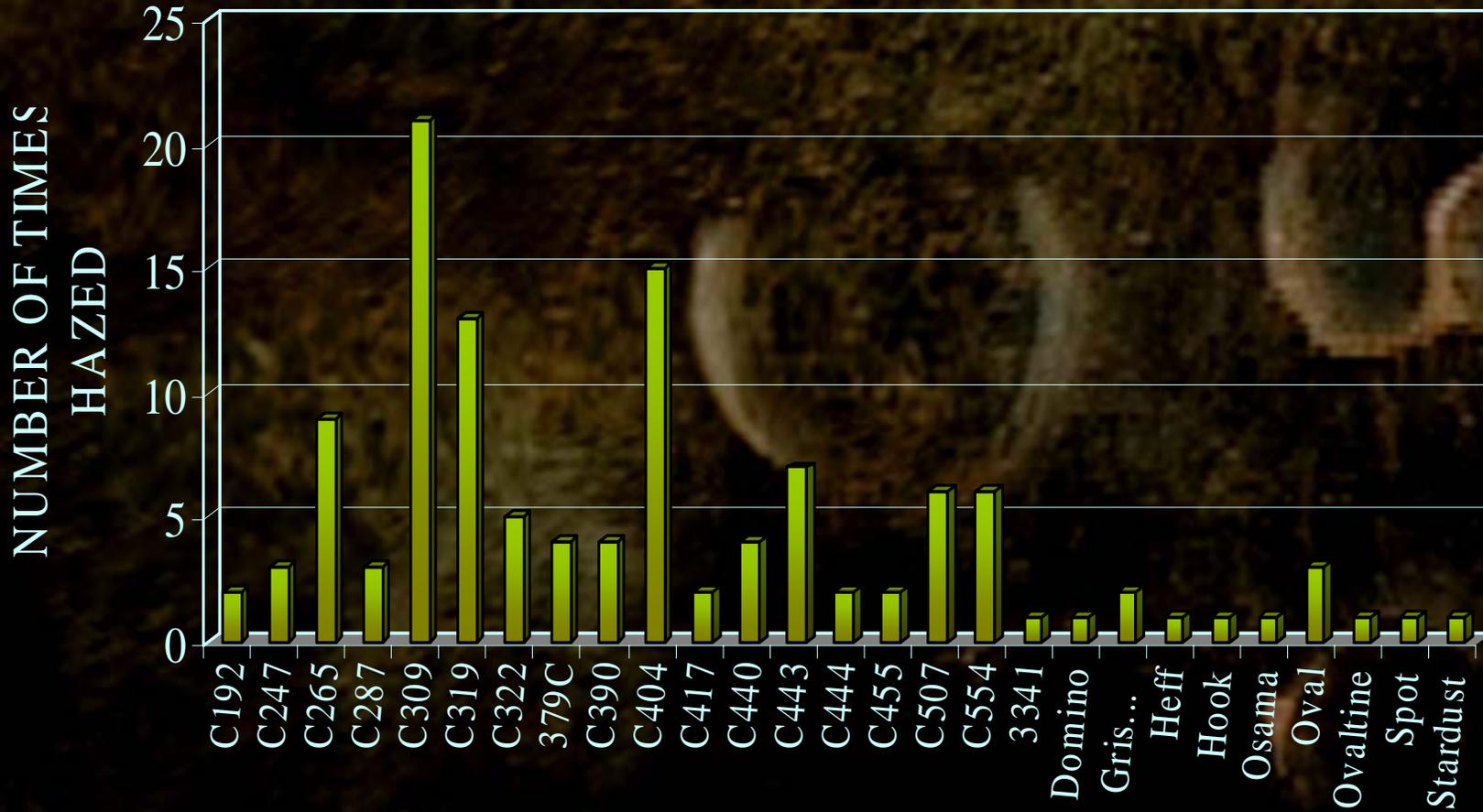
Salmonids that were caught by pinnipeds, but escaped being eaten



Total sea lions hazed per hour - USDA



Hazing frequency, by individual - USDA



■ Pinnipeds Hazed in 2006

IDENTIFIED INDIVIDUALS HAZED

Number of highly identifiable sea lions that returned in subsequent years

| | 2003 | 2004 | 2005 | 2006 |
|------|------|------|------|------|
| 2002 | 81% | 75% | 56% | 38% |
| 2003 | | 59% | 42% | 26% |
| 2004 | | | 61% | 38% |
| 2005 | | | | 57% |