Rub-a-dub-dub: Update on Washing Sea Otters (Oiled Wildlife Infrared Camera Study)

This presentation addresses the effects of washing, rinsing, and the recovery process on the core body temperature, behavior, food intake and water repellency of fur of sea otters. It also examines the use of infrared thermography for documenting insulation loss on sea otters, other marine mammals, and marine birds under spill and experimental conditions, and potentially for documenting the impacts of oil spills on the environment.

Optimizing Washing and Treatment of Oiled Sea Otters: Rub a Dub Dub

SSEP Project Review

May 28, 2008. Sacramento, CA.

D. Jessup; S. Toy-Choutka; F. Batac: CDFG-OSPR-MWVCRC

D. Casper, T. Fink, B. Richter, T. Williams, L. Yeates; U.C.-Santa Cruz, Long Marine Laboratory

M. Murray, A. Johnson; Monterey Bay Aquarium

Sea otters are the most vulnerable marine mammals to oil spills

- Several thousand at killed due to Exxon Valdez in 1989-90.
- Several otters killed Avila Beach, CA oil spill in 1992.
- Ten have died in CA since 1994 due to natural seep and unidentified source small oil spills.
- No blubber, only air trapped in fur for insulation, nearshore feeder, high metabolic rate.
- Otters a major part of OSPR's original legislative mandate.

- Almost all Alaska North Slope crude (one Exxon Valdez size tanker/ day) come through CA waters.
- The USFWS Southern Sea Otter Recovery Plan identifies a large oil spill as the most likely catastrophic event threatening the CA population.

Washing sea otters during Exxon Valdez was controversial

- Setting up facilities was costly and time consuming and central facilities required long transport. Rehabilitation costs criticized.
- It was hard to determine which were oiled and which were not (we have that pretty well solved now).
- It took weeks for the water repellency of the hair coats of washed otters to recover and it was difficult to determine when and why that actually occurred.
- High initial mortality rates during rehabilitation.
- Some sea otters that were not heavily oiled died and had lesions that suggest hypothermia, hypoglycemia and shock, calling the whole washing and rehab. process into question.
- High apparent post release mortality rates.
- Many of the techniques used were based on clinical observation with many uncontrolled variables, or based on very limited empirical or experimental information.
- Can we do any better now ?

Our studies 2005-08, on captive “unreleasable” research trained adult male southern sea otters at the MWVCRC.

- Although Exxon Valdez washing and rehabilitation was stressful, inefficient and heavily criticized, until this study no efforts had been made to do empirical research on washing sea otters (but, mink and river otters have been used as surrogates).
- These studies initially used a reductionist approach. Each step in the process was first characterized and then optimized. Initial steps (Trials 1-3) included anesthesia alone, and rinsing (at 80F and 90F).
- Then the optimized standardized wash procedures employed in a “Latin Square” research trial design, with only 1 variable, water type otters released into for recovery. (Trials 4,5,6 and 8).
- Hypothesis: Recovery in soft fresh water will decrease time required for hair shafts to realign and interlock and for the hair coat to recover its water repellancy
- Primary indicators of recovery included otter behavior, core body temperature and blood values, SQ temp., thermal and photo imaging.
- Otters behavior and core body temperature were monitored on web cam video 24/7 during trials. Otters were under constant immediate care for first 36 hours. Trials were considered over when all parameters back to normal.

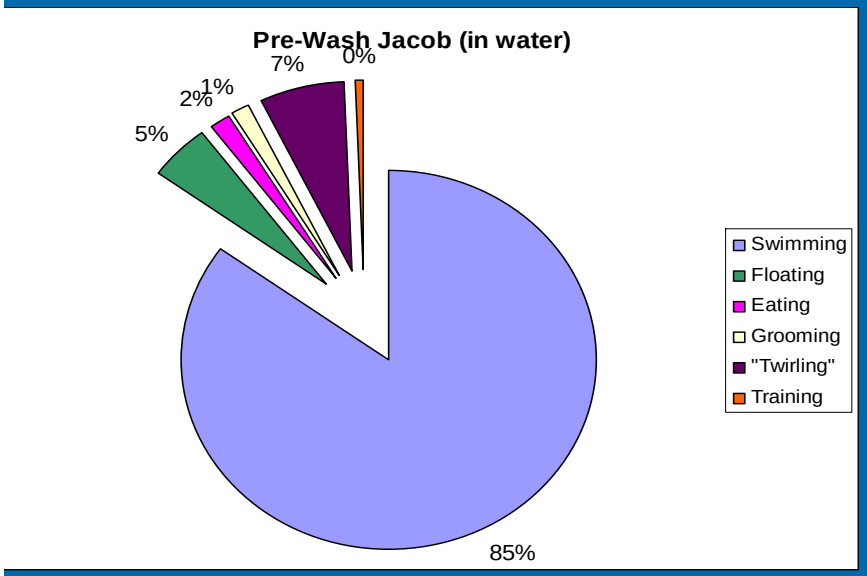
Standardized methods of treatment:

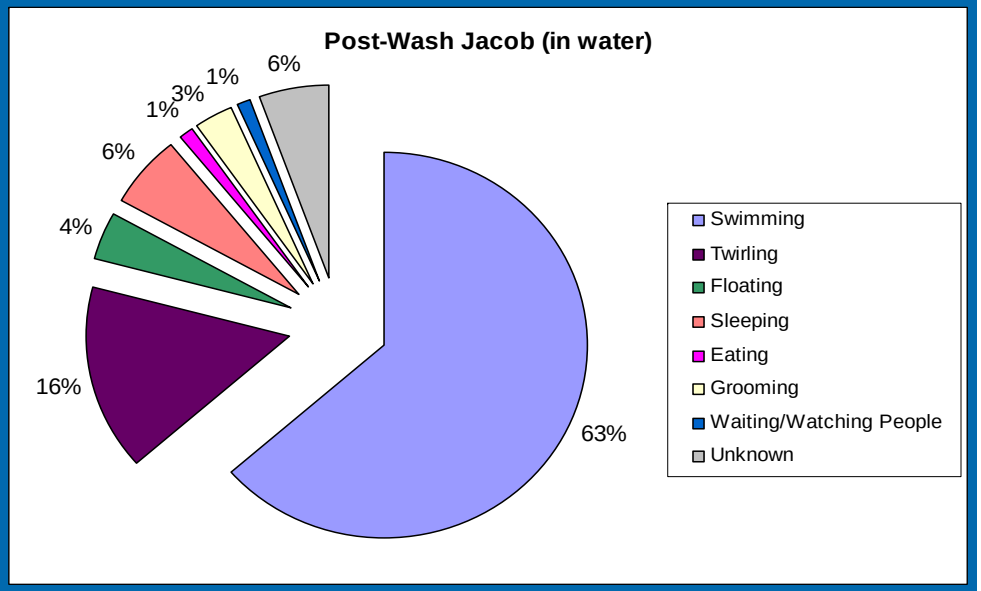
- Induction with .22 mg/kg fentanyl and .07 mg/kg midazolam, maintenance on 1% isoflourane. Reverse in 2 hours with .66 mg/kg naltrexone
- Room temp 60-70F. Proximal 1/4 of otter not treated.
- Blood and other samples; wash front, back, front, back for total of 30 minutes with 6% Dawn in 80F water.
- Rinse front, back, front, back (15 minutes per side) for total of 1 hour with soft water (4 gr. hardness) at 90F.
- Reversal and recovery indoors for 1 hour, release into outdoor pool/pen.
- Trail 4: ambient temp (43-48F) sea water. Trail 5: warmed (60-65F) soft fresh water. Trial 6: ambient (45-50F) soft fresh water. Trial 8 warmed (60-64F) sea water.

Defining and monitoring the outcomes When have they recovered ?

- Washing completely disrupts water repellency of coat (of the 3/4 washed otter) and they get cold.
- When they return to normal behavior patterns ?
- When SQ temps return to normal patterns ?
- When IR thermographic images appear normal ?
- When weight loss or increased need for food to maintain weight returns to baseline ?
- When they return to stabile core body temperature (metabolic rate) ?

How does washing effect behavior Simple answer: a lot more grooming

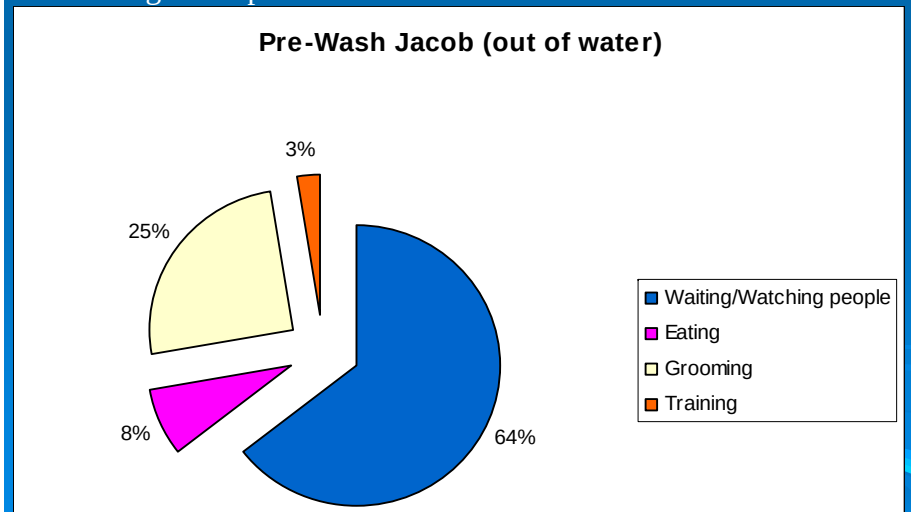


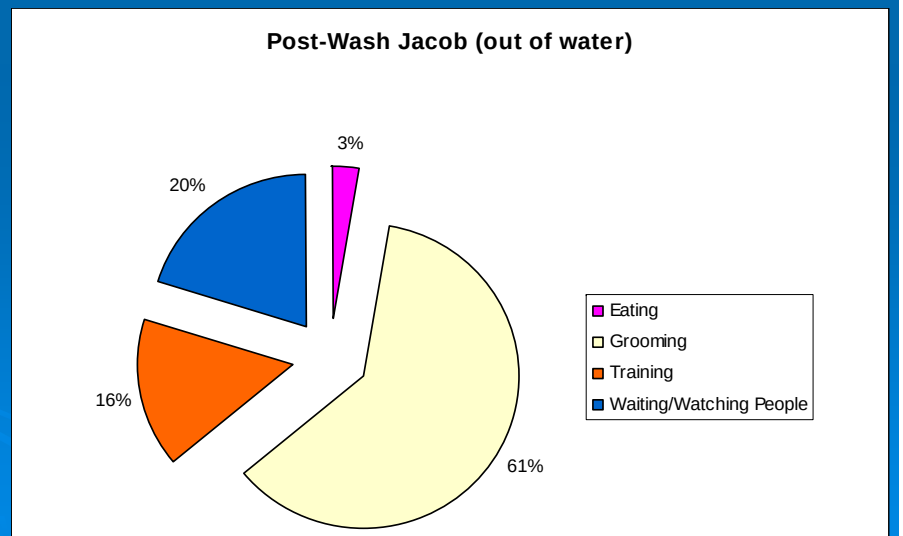


Pre-Wash: Jacob in the water 89% of the time in a 12-hour period.
Pre-Wash: Jacob out of the water 11% of the time in a 12-hour period.
** Grooming is difficult to determine via camera when the animal is in the water. Recorded only the visible grooming in the water. Training and Eating are dependent on the Animal Trainers. **

Post-Wash: Jacob in the water 90% of the time in a 12-hour period.

Post-Wash: Jacob out of the water 10% of the time in a 12-hour period.





- Quite variable by individual, trial number, weather, etc: labor intensive and imprecise

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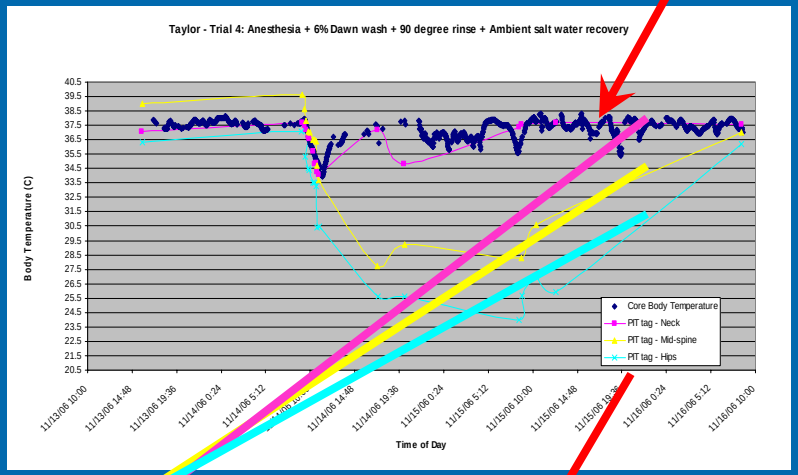
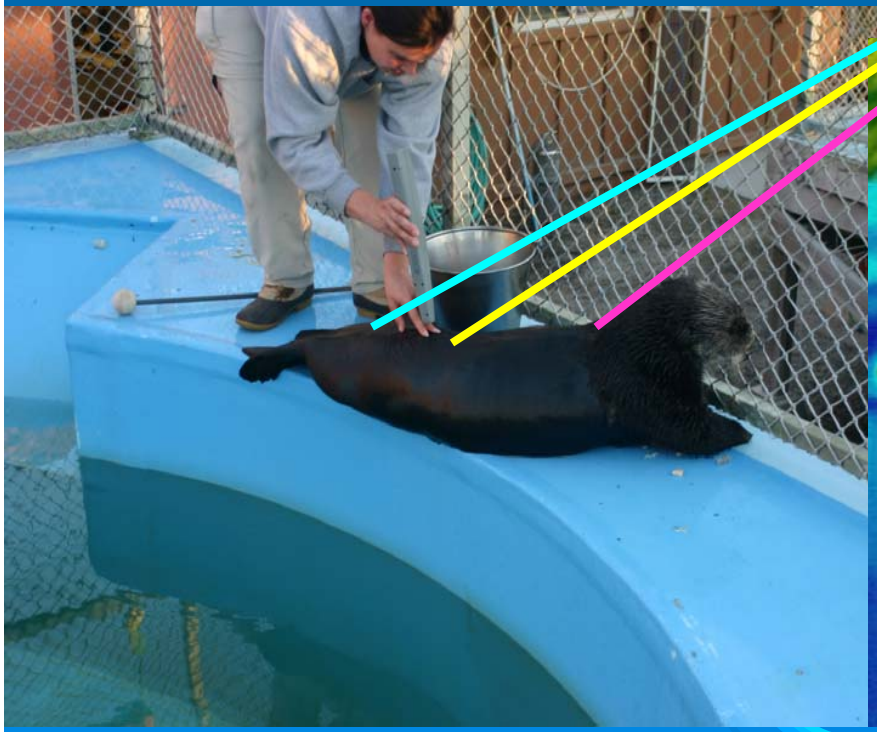
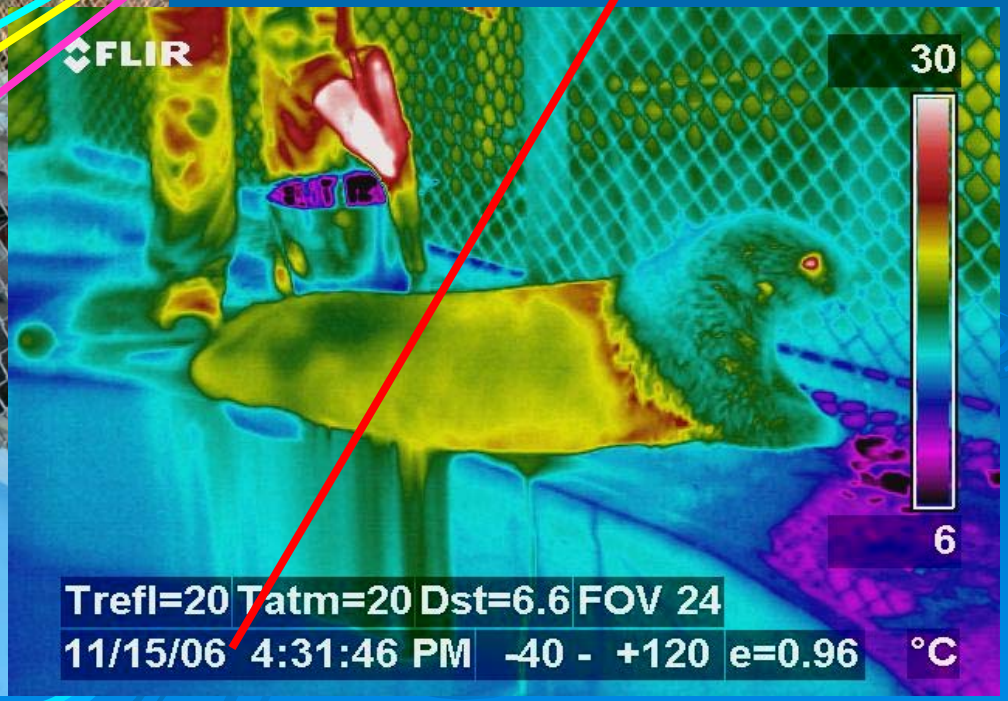
Temperature sensitive PIT tags allow monitoring of subcutaneous temperature before, during and after washing, correlation with core body temp and visual and IR observations

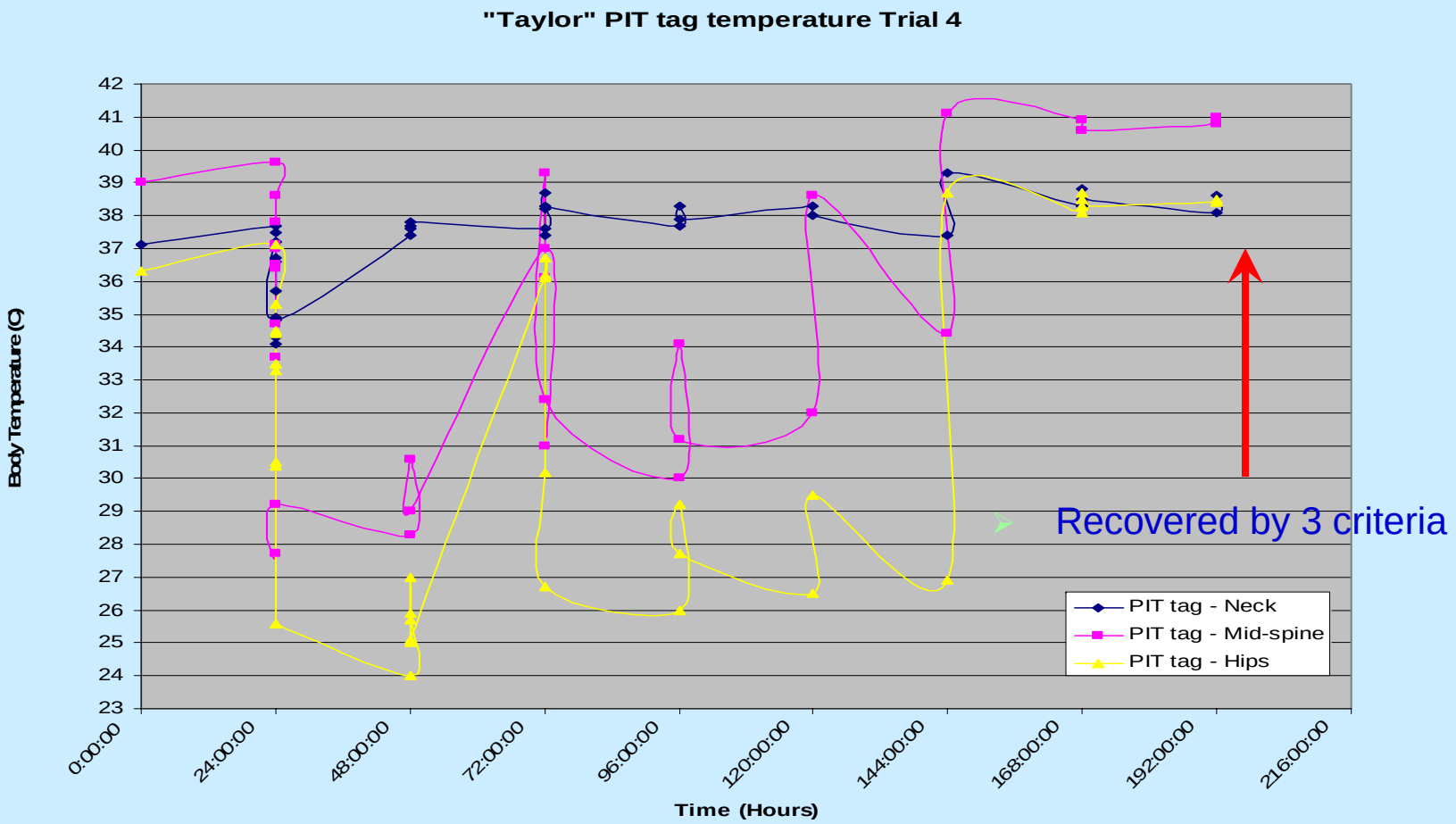
- VHF radio monitoring core body temp





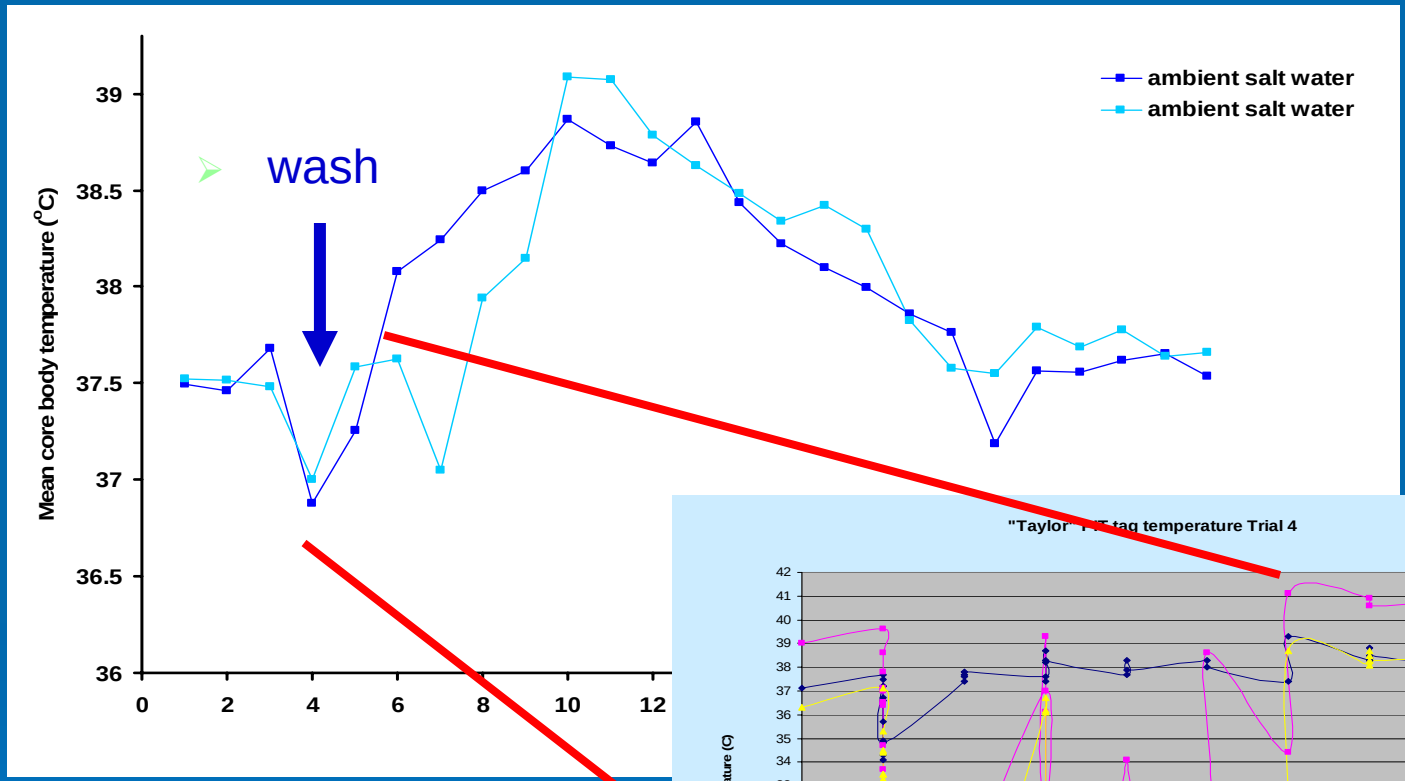


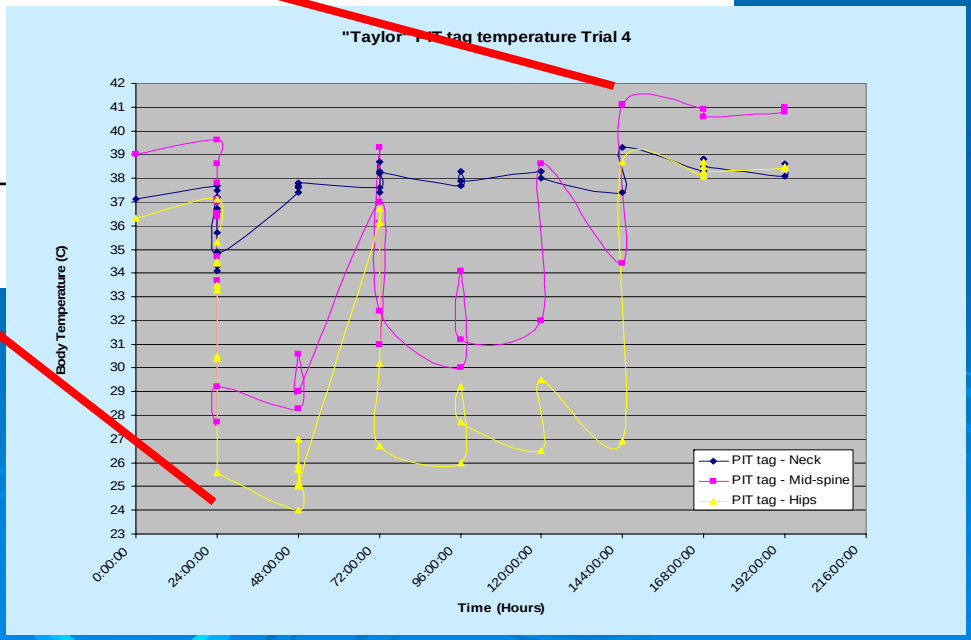
- When subcutaneous temperature patterns return to normal.



- PIT tag temps: unwashed neck area temperature tracks with core temp.
- Rear and back colder initially and respond to solar heating and weather
- PIT tag temps tell when coat back to normal before visual and behavior.

Comparing core body temperature (metabolic rate) to subcutaneous temperature (what the otter feels)

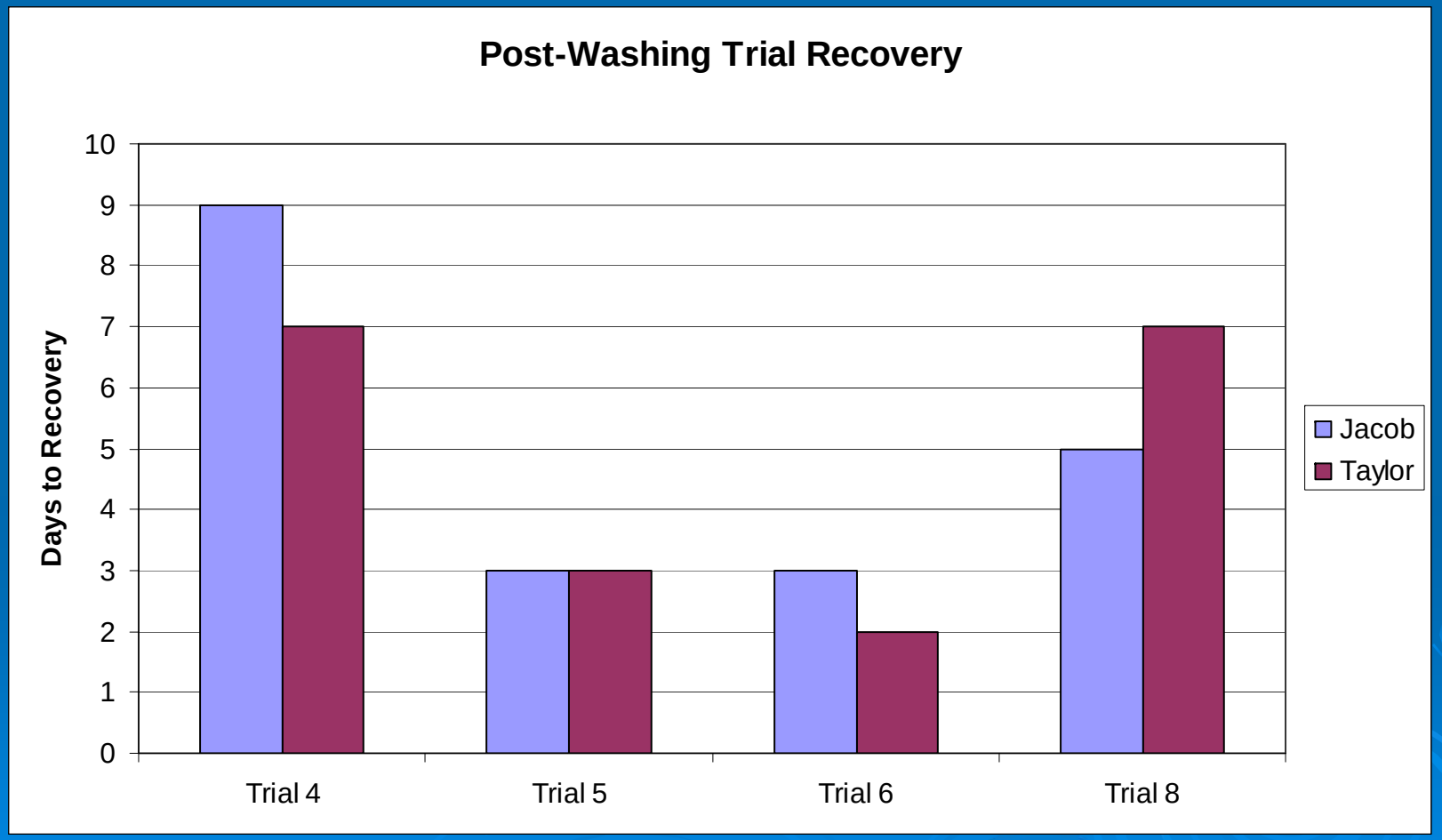




"Recovery" varies by how you measure it. SQ PIT tags tell you when the coat is providing insulation in washed areas, ie when further recovery is likely.

- Washing and experience of cold temperature sets off a metabolic response that lasts about 3 weeks.

Recovery from washing based on normal and stable SQ temp patterns, normal visual and IR thermographic fur properties, return to normal behaviors (all 3 criteria) IT'S THE WATER !!!!



- 4=cold salt, 5=warm fresh, 6=cold fresh, 8=warm salt

When have they recovered ? Defining and monitoring the outcomes

- Washing completely disrupts water repellency of coat (of the 3/4 washed otter) and they get cold.
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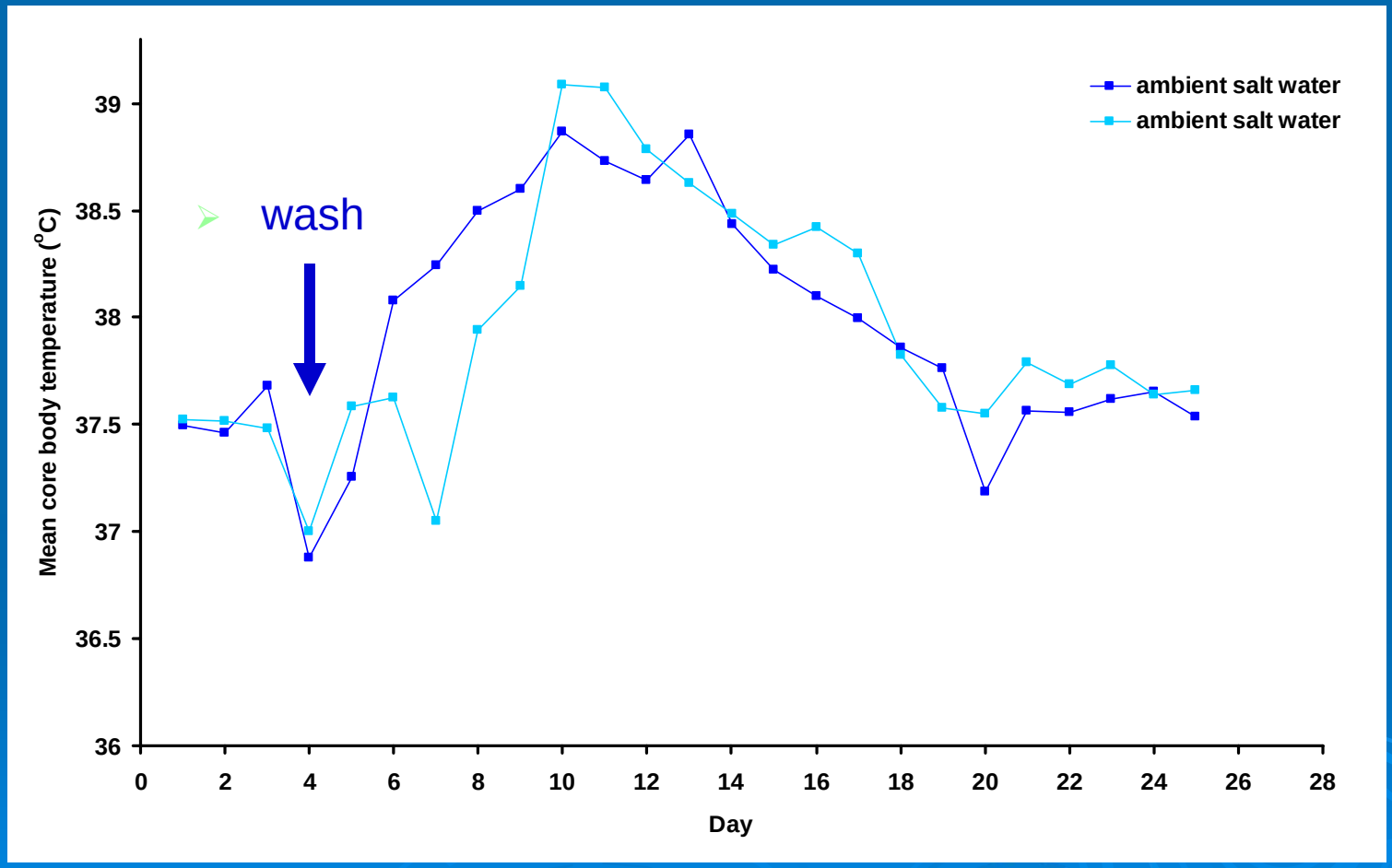
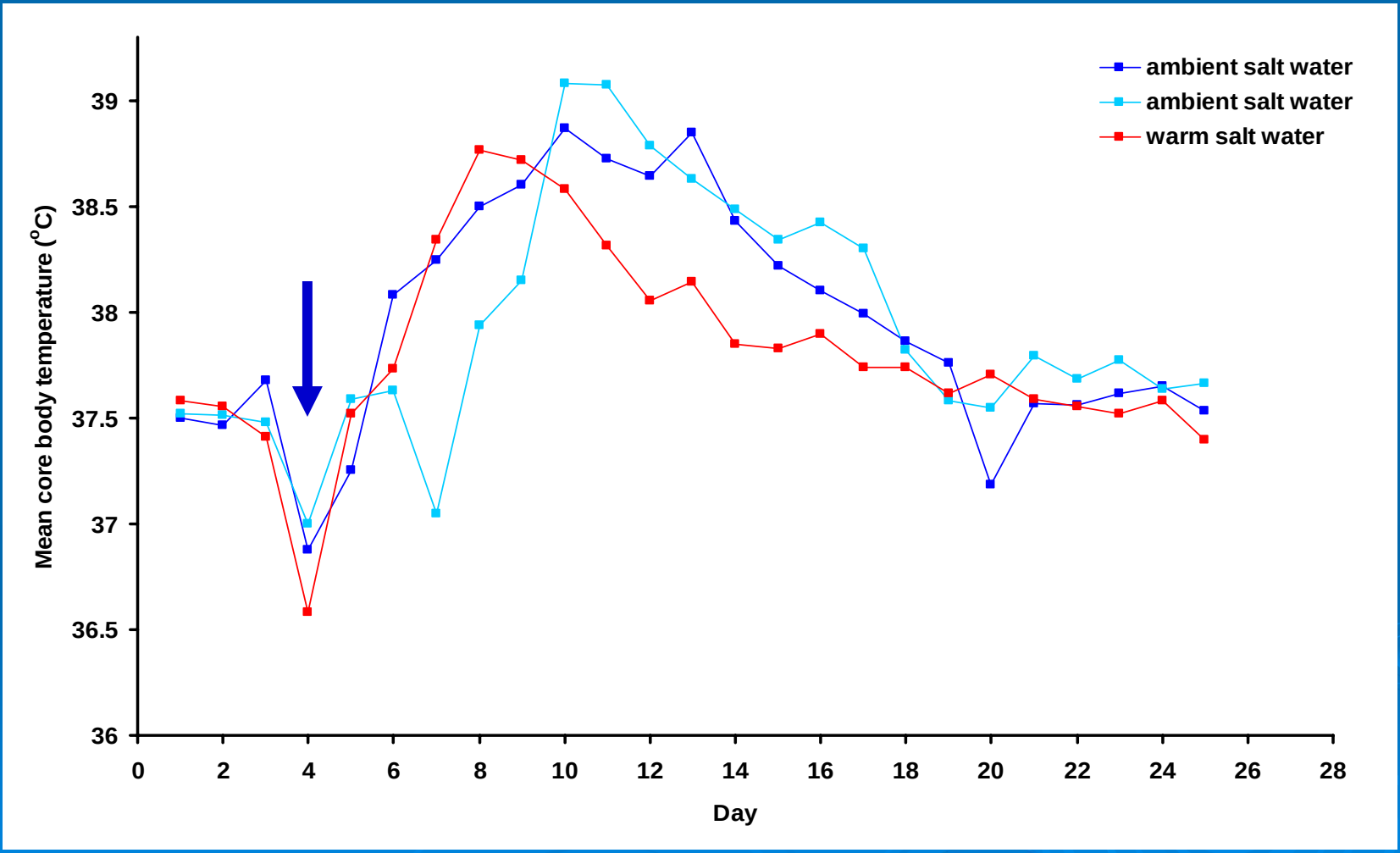
Does learned behavior make a difference ? Comparison of core temps in cold salt water, procedure repeated 6 months and 3 trials apart (trials 4 and 7) , Taylor



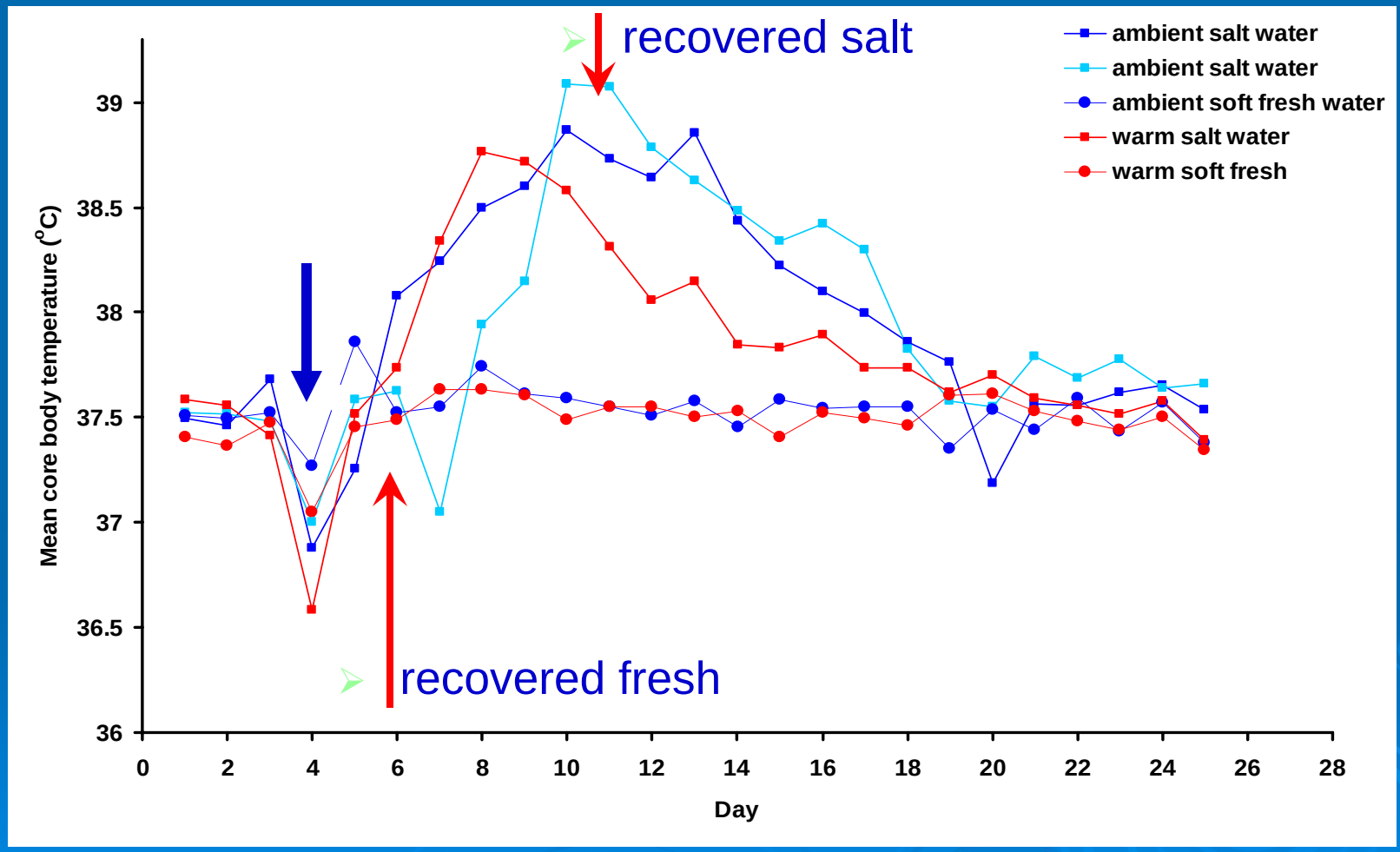
- Answer, apparently not in 43-48F sea water

Does increasing salt water temperature improve recovery time as measured by core body temperature (metabolic) response ?



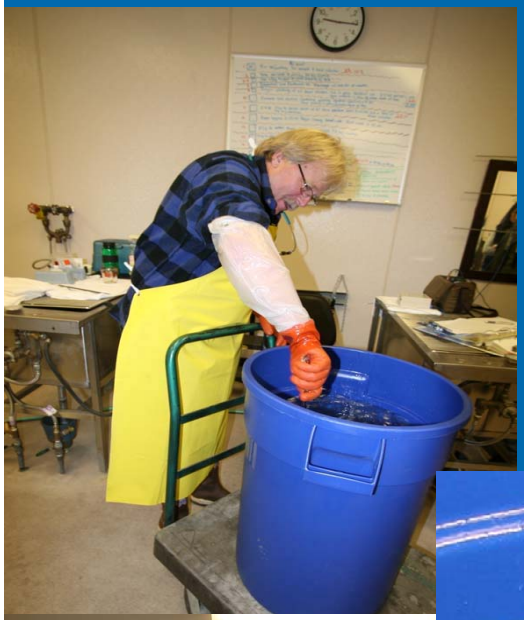
- Maybe a little, but not remarkably at temps of 43-48 F and 60-64 F

Core body temperature (surrogate for metabolic rate) for all 4 treatments, and 1 repeat, Taylor



- It's the water !!! And metabolic recovery takes longer than coat recovery

Does oiling make a difference ?



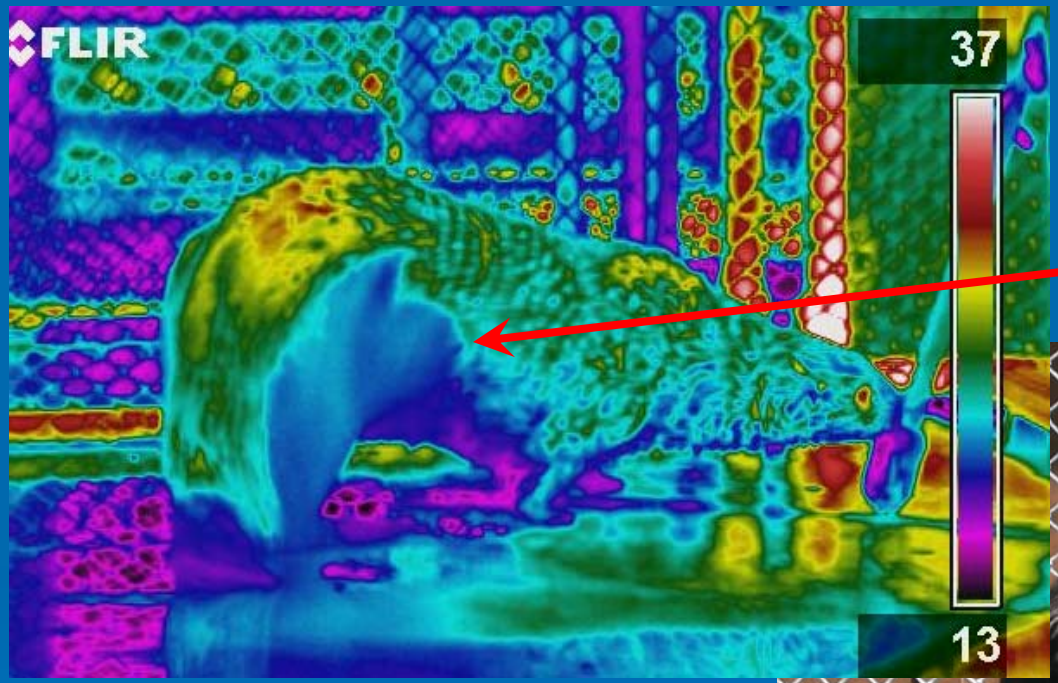
30 gallons ambient temperature sea water + ½ cup canola oil, stir for 4 minutes. 2mm slick

Dip ½ otter 4 times

Massage in oil water mixture 10 minutes.

Wash as usual but reduce rinse to 40 min

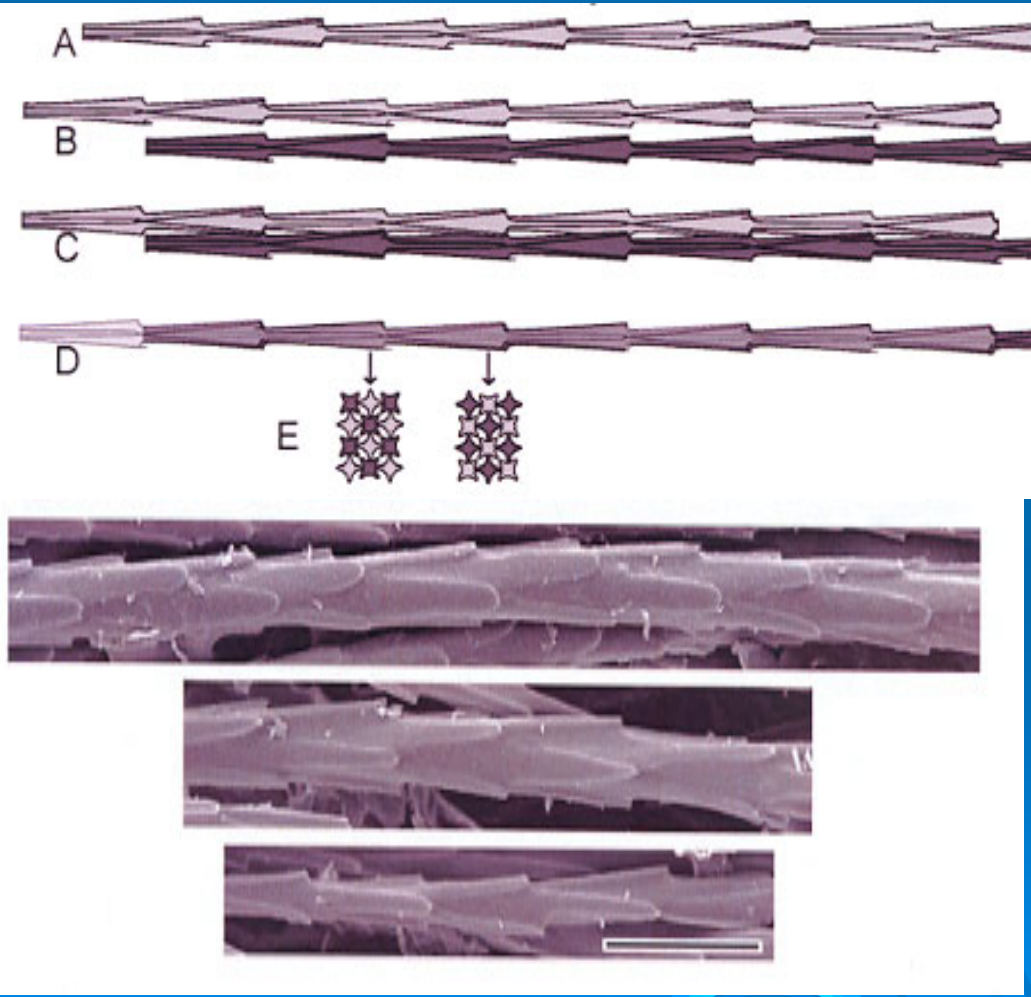
Apparently not, recovery in warm fresh water as fast or faster than when unoiled.

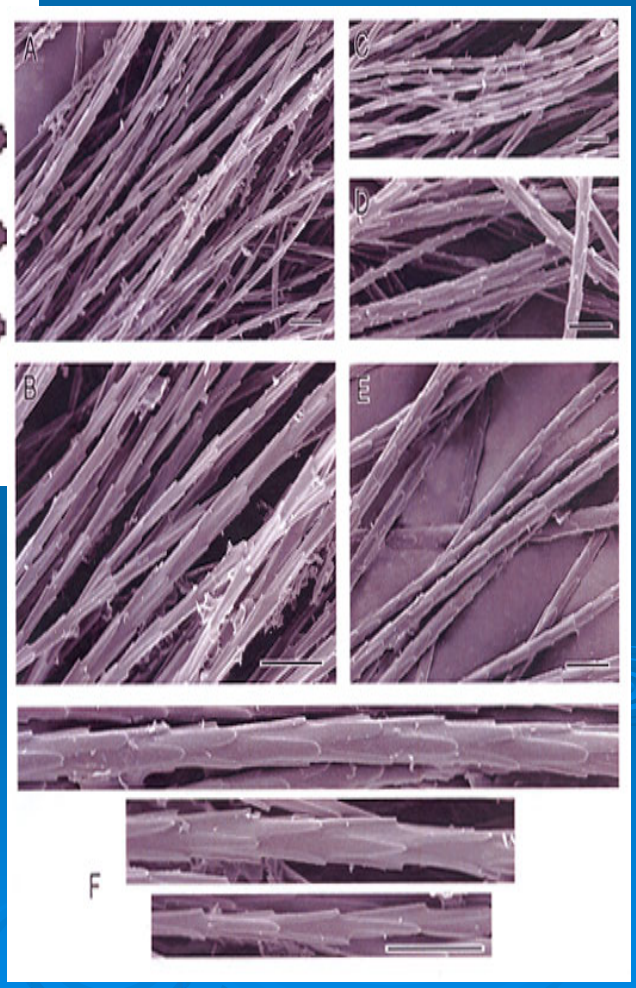


- Areas where coat still waterlogged. Thermal image and photo taken 22 hours post wash.

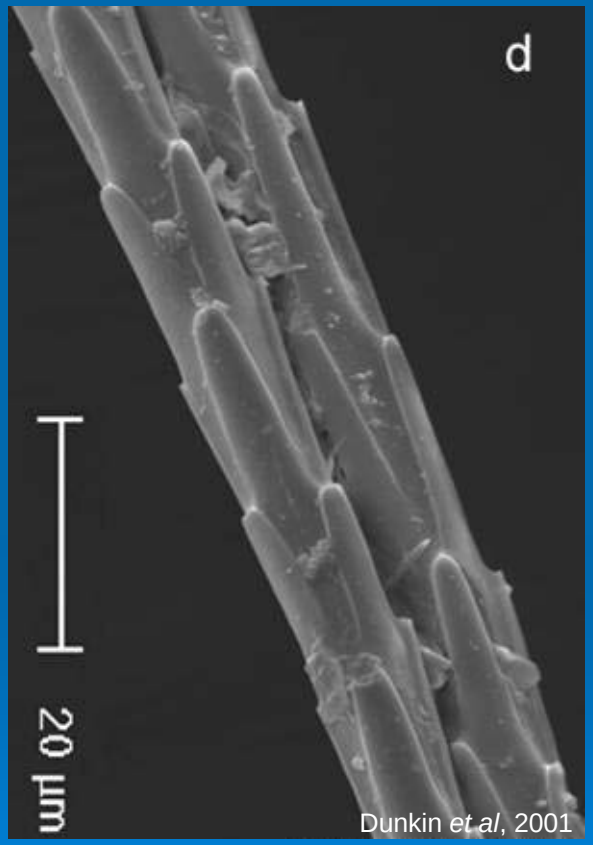
- Fully recovered by approx. 48 hours. Note: only 1/2, not 3/4 of the otter washed, may help improve recovery time.

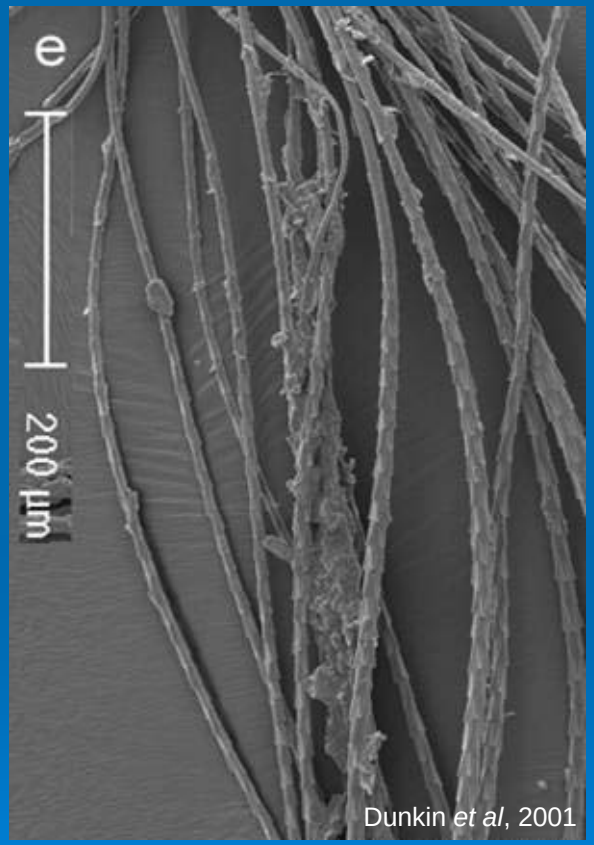
Why does fresh water make a difference ? Otter under fur, like bird feathers has a 3 D structure. Interlocking hair shafts and surface tension keeps water out and air trapped.

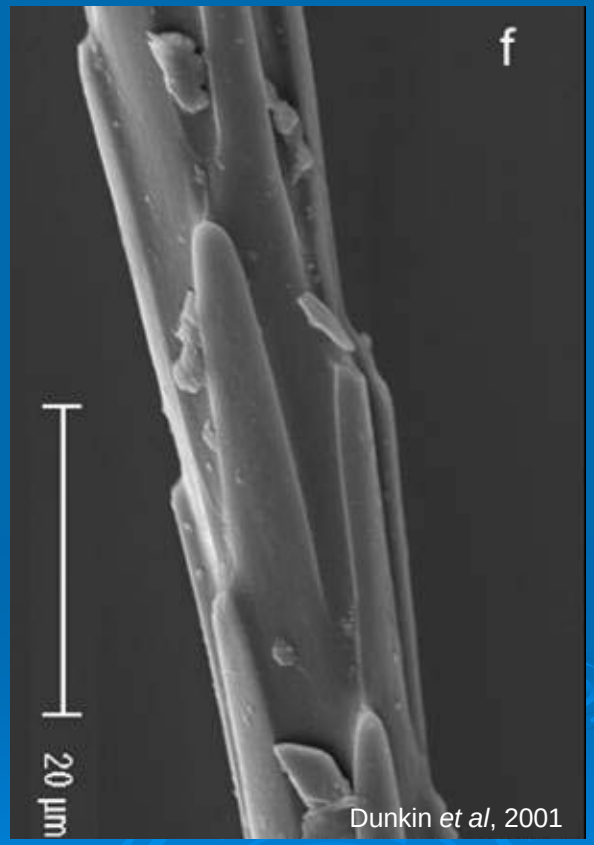




After standard washing and rinsing of pelts with hard tap water (as done in Alaska) crystals and some amorphous material (soap scum ?) remains on hair shafts







River Otter **Mink** **Sea Otter**

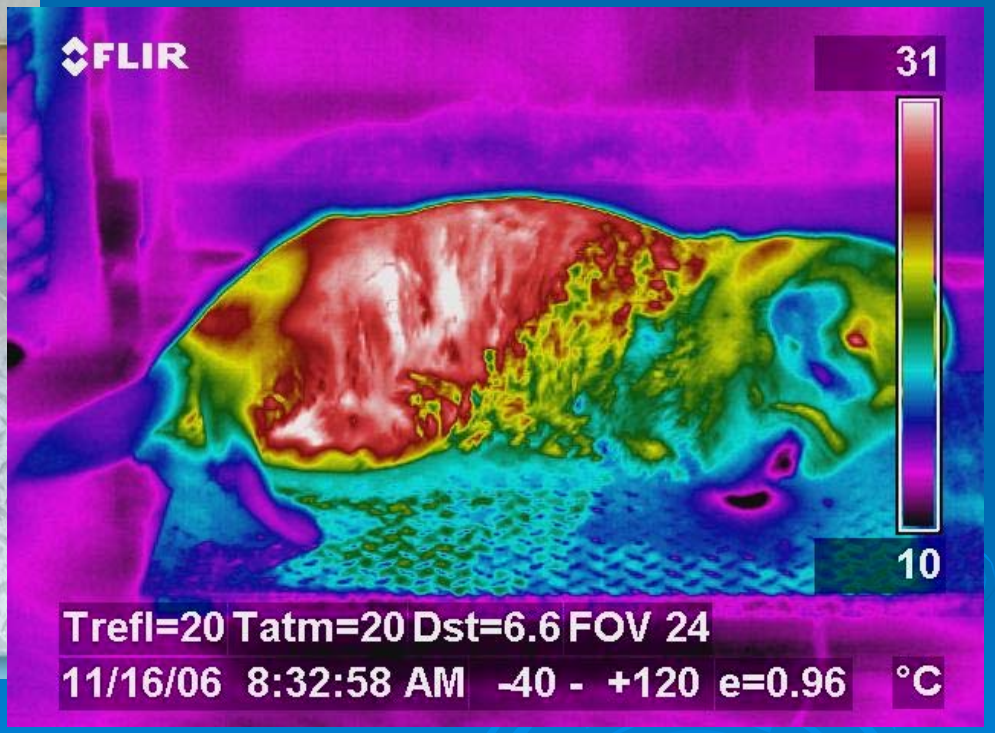
What we now know

- Core body temp can be allowed to drop to the low end of normal range about 95 F, but you must be prepared to warm them up by increasing rinse temp to 95F.
- Washing and rinsing with soft water at 90-95F optimal, release into soft water for 24-48 hours makes a HUGE difference, may even allow reduced rinsing time.
- Core temperature important “emergency” parameter until coat recovers, but “overshoots” due to increased metabolic rate. SQ temp more accurately reflects when coat recovery has occurred.
- IR thermography, SQ temp. and observation are useful, but the former two are less time consuming and perhaps more precise. Sum of the 3 criteria defines recovery.
- Natural oils may be much less important than previously thought. Optimizing conditions that encourage grooming behavior and allow hair shafts to interlock and form plates may be much more important.
- Swimming in softened fresh water for 24-48 hours makes them more comfortable. Warmer water may help with sicker otters. This promotes swimming, grooming, eating and less frantic behaviors and can reduce time till coat recovery and temperature stability by about 50% (maybe more) and head off medical problems.
- It even works better when they are (canola) oiled !!!!
- In an oil spill we believe this could greatly improve individual animal outcomes, decrease time and expense, shorten recovery times and time to release, hopefully improve survival in the wild.

Other veterinary and management improvements since Exxon Valdez

- We don't have to build facilities in the face of an emergency, we have 1 dedicated facility (Santa Cruz) and several others that can assist (Monterey Bay Aquarium, TMMC, Sea World, Aquarium of the Pacific and UC Santa Cruz).
- Drilled and trained care crews, core at MWVCRC + MBA + UCSC and will incorporate findings into OWCN trainings.
- Better capture and transport.
- Floating pens.
- Improved anesthesia drugs.
- Improved monitoring protocols.
- Better understanding of physiology, endemic health problems and pathology.
- Better triage criteria.
- This week an industrial size water softening system is being installed at the MWVCRC.

Conclusion: Some new but fairly simple techniques and technologies can potentially improve outcomes of having to wash oiled sea otters. We can probably do much better than we did at Exxon.



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Stay Tuned For Phase III, Otters Revenge

Special thanks to
Jacob and Taylor