Rub a Dub Dub: Investigating the Thermoregulatory Physiology of Washing Sea Otters

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Abstract: The primary means of removing oil from sea otters is washing them in dilute detergent with prolonged rinsing in warm water, forced air drying, and recovery with variable access to sea water (Williams and Davis, 1995). The process of anesthetizing, washing, rinsing and drying sea otters, each taken alone, and the animals recovery and introduction to water are a series of complex interactions between an animal with a very high metabolic rate, little body fat, and its environment. Using a deconstructionist science approach, the thermoregulatory effects of each of these steps are being investigated under controlled circumstances, so that the influence of each step on the success of the whole operation is understood.

Materials and Methods: Male southern sea otters deemed “unreleasable” by USFWS were obtained and trained them for medical behaviors, voluntary photography and equipped with temperature monitoring devices. Otters have been separately run through the stages of anesthesia, rinsing at 80F and at 90F and washing with dilute detergent and recovery in ambient temperature sea water.

Results: Although the project is only about half completed, we have made several very interesting observations:

1. Sea otters are not as homeothermic as most terrestrial species. Their core body temperature regularly varies over a range of about 4F during any 24 hour period depending on behavior, use of water and water temperature, and other factors.

2. Although one might expect anesthesia and immobility for the two hours required to wash and rinse a sea otter to result in lowering of core body temperature, body temperature rises about 2F.

3. The temperature of rinse water (only 80F and 90F were tested) made no diference in the rate of core body temperature loss, it declined 2F over an hour.

4. Although rinsing at 80f and 90 f seem to do very little to change sea otters coat quality and water repelancy, washing with detergent in the manner required to remove oil destroys water repelancy.

5. Based on electron micrographic imaging of river otter pelts it appears that scales and shafts of the hair form interlocking water tight plates that trap air against the skin and keep water out. Physical interlocking and electrostatic forces are believed to help hold these plates together.

6. Our previous electron micrographic evaluation of mink, river otter and sea otter pelts show similar structure and mock washing of pelts suggest that salts and amorphous debris may accumulate on hair shafts reducing their interlocking and water repelancy.

Discussion: When oiled birds are washed it has been observed that, if they are not allowed to first recovery and preen in softened fresh water, they seldom rapidly regain water repelancy. This has been shown to be due to crystallization of salt in the interlocking feather matrix disrupting the physical barrier to water intrusion. We believe the same may be true for sea otters and that sea otter fur may have physical characteristics that depend on three dimensional structure for water repelancy much as the interlocking bars, barbules and shafts of feathers do. We intend to test this hypothesis using a variety of tools including electronmicroscopy, infra red thermal imaging, thermal sensitive microchips and behavioral response of sea otters to softened fresh water as opposed to sea water. We are also testing whether raising the temperature of the water in which sea otters must recover water repelancy has beneficial results.