Letter from the Desk of David Challinor
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City dwellers might not immediately recognize skunk scent, but rural and even suburban inhabitants certainly do. In fact, most of us spontaneously associate the word "skunk" with this New World weasel family's (mustelid's) odoriferous defense against mammalian predators. Many other animals emit characteristic smells for self-defense as well as for other general and highly specialized purposes: to find food, for intraspecific recognition, to mark territorial boundaries, to repel insects and other ectoparasites, to signal when ready to breed and—as I reported in last month's letter regarding kangaroos—to find the pouch of the marsupial mother.

Most birds, however, lack a keen sense of smell. Although skunks can spray their distinctive scent with great accuracy and effectiveness, this defense fails to deter predators such as hawks and owls, even at very close range. With some exceptions, birds do not use their sense of smell to find food. The spectacularly-plumaged black and white King Vulture of tropical America lives in dense jungles where dead animals are hard to see. How else than by smell can it find its food so promptly? The common Turkey Vulture has shown in experiments that it, too, can find carrion by smell when flying low.

It is only recently that scientists have learned that a few disparate bird species use smells as mammals do for defense against potential predators. Although hawks and owls may not smell the spray of a skunk, we have learned that many birds share the skunk's ability to emit a spray that will deter those who threaten them. Among the birds that have mastered this technique are the fulmars—gull-like birds belonging to the order of Tube-nosed Swimmers (*Procellariiformes*) which includes albatrosses, petrels and shearwaters. The North Atlantic Fulmar breeds in large cliff-face colonies, and when I visited Iceland in the 1970's, I experienced just how accurate their defense can be. I was crawling on my hands and knees to the edge of a steep seaside cliff to look closely at the nesting birds when the first one that saw me squirted a pale oily liquid straight at my head through the tube on its bill. I ducked, but some of it hit my wool cap. It had a strong musty smell and became waxy in the cool air. The smell remained as long as I had the cap, despite repeated washings. I later learned that even nestlings have this skill and, like their parents, can squirt accurately at distances greater than four meters. Smell is important in other ways as well to this pelagic order of birds. Many petrels, for example, are colonial hole-nesters, and when parents return at night to feed their single slow-growing chick in its nest chamber at the end of a meter-long burrow, each parent evidently finds its own young by smell.

Two species of ducks and a hoopoe have a particularly foul excreta. When a shoveller or an eider is unexpectedly flushed from its nest, it sprays its eggs with malodorous feces to discourage the intruder from eating them. The king of the "smellies" is the hoopoe. The common Eurasian Hoopoe is a thrush-sized bird with a curved beak and a large crest with black- and white-tipped feathers, which it raises and lowers frequently. It generally uses no nesting material; nonetheless, the nesting site is not only filthy but exudes a strong repulsive smell. The related Green Woodhoopoes of East Africa, when disturbed in their nest holes, face away from the intruder and squirt a foul smelling discharge from their uropygial gland at the base of their tail, which remains persistently on the squirtee. Among its components is dimethyl-sulphide, which chemistry buffs will recognize from its rotten egg smell. There do not seem to have been any experiments yet to check the effectiveness of this defense, but it would seem reasonable to assume that it would be a deterrent to small mammals seeking the eggs or hatchlings. The kingfisher's nest hole has the strong smell of rotting fish, but I do not know of any research that has shown its protective efficacy. I doubt that a snake or a hungry rat would be deterred by this smell alone.

The Hooded Pitohui emanates an acrid, sour smell from its plumage, and research has taught us a great deal about the efficacy of its odor. This oriole-sized bird is brightly feathered in orange and black and inhabits the forested mountains of New Guinea. A Smithsonian scientist, J.P. Dumbacher, when disentangling a pitohui from a mist net, was bitten and scratched by the bird. When he automatically put his hand to his mouth to lick the wound, his mouth became numb. Through further investigation, he learned that local hunters carefully avoided using this bird as food. Alerted by the reaction he sustained from licking his scratch, he suspected that the bird's acrid smell might be related to some defensive compound on its skin and feathers.

Dumbacher found, in a laboratory test, that lice avoided living in pitohui plumage, and that those that were physically constrained to remain in these feathers lived significantly shorter lives than those in feathers of other birds. Even more amazing, further investigation showed that the pitohui feathers contained batrachotoxins—the same chemical compounds as those found in the skin of poison arrow frogs. These are powerful poisons that are more than 250 times stronger by mass than strychnine. The source for the batrachotoxins in both the pitohuis and the frogs is thought to be melyrid beetles, of which there are 5,000 species with a global distribution. Toxic compounds are stored in these beetles, which have been found in pitohui stomachs. The next step is to learn where and how the beetles acquire the toxins. It is of interest to note—and serves as confirmatory evidence of the results of available food choice in the wild and in captivity—that the poison arrow frogs in the National Zoo's exhibit have lost their toxicity because of their changed diet.

Enough of the smellies! There is fortunately one bird group with a good smell, at least as perceived by humans. The quail-sized Crested Auklet lives in rocky coastal colonies in Alaska and northeast Siberia. They are attractive-looking black birds with a longish neck, white-rimmed eyes, and an orange-red bill, named for their forward-

curving tuft of feathers at the top base of their bill. Because their breeding colonies are so remote, not many bird watchers have seen them in the wild, but the Cincinnati Zoo maintains a small colony. The auklets are interesting because they produce a strong citrus odor some have described as tangerine. I have never smelled it, but a colleague who worked in Alaska reported that the aroma is strong enough to be picked up by humans located as much as a half-mile down wind. I imagine some early explorers must have been baffled to detect such an enticing, tropical smell in the Arctic.

The auklet's smell occurs only during the breeding season, and scientists have learned that the birds produce this remarkable odor from glands in their necks. During courtship the birds are expert neckers, a term common during my teenage years when the really cool young dudes had a "necker knob"—or spinner—on their steering wheel, which allowed the "necker," when driving with his girlfriend, to steer with only one hand. The auklet necks more literally. While swimming, one bird closely follows alongside its mate with its bill snuggled in the other's neck feathers. On land, the same neck-intertwining is practiced, and scientists speculate that the necking and head grooming, which releases compounds through tiny tube-like wick feathers on the neck, may partially control the ticks that occupy those parts of the bird that they cannot preen themselves. Further experiments on the benefits of the allopreening will doubtless be forthcoming, but evidence is accumulating that Crested Auklets are the first birds found to anoint each other with a compound that seems to be both a tick repellant and a mate-attractant. Alloanointing is not uncommon in mammals, but this is the first report of such behavior in birds. Interestingly, the fourteen adult auklets at the Cincinnati Zoo have so far failed to produce this scented compound, for reasons as yet unknown, but which may—as in the case of the poison arrow frogs—be due to a change in diet.

We have long known the important role smell plays in the lives of animals, and in humans as well. If we smell smoke, we move towards the nearest exit. We can sometimes remember and capture smells better then visual images, despite the fact that sight is our dominant sense, just as hearing is for bats and for the almost blind river dolphins that successfully navigate and capture prey by echolocation. The smell of bone meal can bring back memories of grandfather's vegetable garden. A whiff of perfume in a crowded elevator can remind us of someone we love. Our sense of taste can be equally evocative, as it was for Marcel Proust, when he bit into a madeleine and was flooded with memories of times past. There is much to learn about senses in the animal kingdom and the still undiscovered senses, not only among animals but in plants as well (see October 2006 *Letter from the Desk of David Challinor* on interplant communication). Particular interest focuses on finding possible other sensory organs in birds. A boundless store of new discoveries in this field awaits current researchers, which is why so many scientists say their work blurs the distinction between work and fun.

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P.S. Two papers well worth studying for further details on the role of smells and how they are produced and used are:

Hagelin, J.C. and I.A. Jones. 2007 Bird Odors and other Chemical Substances: a Defense Mechanism or Overlooked Mode of Intraspecific Communication*?* Auk. 124 (3): 741-761.
Douglas, H.D. 2007 Prenuptial perfume: Alloanointing in the social rituals of the crested auklet (*Aethia cristatella*) and the transfer of arthropod deterrents. NaturwissenshaftenDOI10.1007/s 00114-007-0294-3. (Online)