D51 Testing the Ability of Birds to Detect Forensic Odorants: Comparison With Canine Abilities and Instruments

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After attending this presentation, attendees will learn some basic objectives in the area of avian olfaction and the potential uses in forensic applications. As this is a new area of study, this presentation will provide initial insights into the uses of an alternative biological detector for target chemical odorants of importance to the forensic community.

This presentation will impact the forensic science community by presenting novel techniques in biological detection for target forensic odorants using birds as a potential tool in this context.

Historically, birds have been thought to be functionally anosmic (smell-blind). However, recent work has shown that some species use olfaction in behaviors ranging from foraging, navigation to kin, and nest recognition and that their sense of smell rivals that of dogs. Because this work is relatively recent, little is known in avian species on the evaluation of olfactory sensitivity to specific odorants and direct comparisons to the olfactory tracking power of canines have not been made. To date, most work in this area has been focused on Procellariform seabirds, which have among the largest olfactory bulbs of any bird. This study builds on recent advances in bird olfaction, and combines these approaches with studies of explosive volatile organic compounds (VOCs) and canine odorants for the evaluation of explosive analog odors in a forensic application evaluating birds as a possible biological detector.

In this study, the primary model being used is Leachs' storm petrel (Oceanodroma leucorhoa). This species has one of the largest olfactory bulbs of any bird, and Nevitt's group has developed methods for testing olfactory abilities with respect to burrow recognition. Leach's storm petrels nest on offshore islands and are able to relocate their burrow among hundreds by olfaction. Our study co-opts this nest-recognition behavior to investigate sensitivity to explosive analogue compounds. For example, 2,4-dinitrotoluene and 2-ethyl-1-hexanol are important volatile compounds used by canines to identify cast and polymer based explosives. We are adapting similar odor delivery methods currently employed for canine explosive detection and training to scent artificial burrows. This allows us to screen biological detection ability at different concentrations with known permeation rates under field conditions. Controlled odor mimic permeation systems (COMPS) were chosen as an optimized method of delivering known concentrations of an odor mimic. COMPS devices are polymeric devices providing differing quantities of volatile compounds in a field setting. Previous studies have shown the efficient use of COMPS devices in determining olfaction thresholds using canines as experimental models as well as for determining instrumental detection limits. COMPS devices have never been used on birds even though recent studies show that olfaction plays a much more important behavioral role in some avian species than previously thought. Because these studies are relatively recent, not much is known of the olfactory sensitivity of these birds to a wide range of odors.

Initial experiments entailed an instrumental evaluation of various nest materials to identify naturally occurring VOCs as a foundation to understand the types of VOCs that are innate to their environment prior to introducing target odorants for detection. Using a forensic analytical approach, preliminary data corroborate behavioral results suggesting that most burrows have an individual chemical profile. Behavioral experimental assays were also conducted using established Y-maze and choice test approaches using target explosive odorants such as 2-ethyl-1-hexanol with both adult and chick Leach's storm petrels. These odorants were presented at varying concentrations to monitor behavioral thresholds. Data from behavioral field assays suggest that the olfactory threshold for 2-ethyl-1-hexanol is comparable (and even lower) than that of canines. These results indicate that birds are capable of detecting forensic odorants, such as the explosive odorants tested here, at levels of forensic importance.

Birds, Forensic Odorants, Olfaction

