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AN IMPROVED LIGATURE TECHNIQUE FOR DIETARY SAMPLING IN NESTLING BIRDS

RON S. MELLOTT
The Institute of Wildlife and Environmental Toxicology
Clemson University
P.O. Box 709
One TIWET Drive
Pendleton, South Carolina 29670-0709 USA

PAUL E. WOODS
2015 SE 21st Place
Issaquah, Washington 98027 USA

Abstract.—Toxicological field studies were conducted in 1989 on 12 sites in north-central Washington and 12 sites in south-central Pennsylvania. Among the study objectives was an evaluation of the potential for exposure to nestling birds to an organophosphate insecticide. Artificial nest boxes were placed and subsequently inhabited by the European Starling (*Sturnus vulgaris*). Diet, and the potential for exposure, were assessed by applying ligatures to the nestling birds and removing the food items they were being fed by the adult birds. The study allowed us to compare the effectiveness and ease of use of pipe cleaners and electrical cable-ties as ligature devices. Results indicated that given inexperienced personnel and minimal training, cable-ties resulted in the collection of twice as many crop samples with a lower rate of mortality than pipe cleaners. Food samples were collected 32% of the time using pipe cleaners, with two mortalities in 314 ligature crop sampling attempts. In contrast, food samples were collected 63% of the time using electrical cable-ties, with two mortalities in 594 crop sampling attempts.

UNA TÉCNICA MEJORADA PARA OBTENER MUESTRAS DE LA DIETA OFRECIDA A PICHONES

Sinopsis.—Durante el 1989 se condujeron estudios toxicológicos en 12 localidades de la parte nor-central de Washington y 12 de la parte sur-central de Pennsylvania. Los objetivos del estudio incluyeron el evaluar el potencial de exposición de pichones a insecticidas organoclorinados. Se colocaron cajas de anidamiento que subsecuentemente fueron utilizadas por estorninos (*Sturnus vulgaris*). La dieta de los pichones y el potencial de exposición a pesticidas fue estudiado colocando ligaduras en el pescuezo de las aves y removiendo el alimento que era traído por los adultos. El estudio permitió comparar entre la efectividad y facilidad del uso de limpiadores de cañerías y la utilización de ataduras de cables eléctricos para obtener muestras de alimentos traídos a los pichones. A pesar de la utilización de personal inexperto con adiestramiento mínimo, los resultados demostraron que el uso de cables da lugar a la obtención del doble de las muestras de alimentos con una tasa menor de mortalidad, que el uso de limpiadores de cañerías. Utilizando removedores de cañerías, se coleccionaron muestras de alimentos en el 32% de las ocasiones, con dos individuos muertos en 314 intentos de obtener muestras. En contraste, se coleccionaron muestras de alimento en el 63% de las ocasiones utilizando ataduras de cables eléctricos, con tan sólo dos individuos muertos en 594 intentos de tomar muestras.

Ligatures are valuable tools that have been used in the analysis of diet composition in altricial birds (Johnson et al. 1980). Ligature methodology involves applying a constricting band around the neck of an altricial nestling with sufficient pressure on the proventriculus to prevent the individual from swallowing food items brought to the nest. The ligature

remains in place for a period, often 1 h, after which the investigator returns to remove food items from the upper digestive tract, massage the crop to disgorge its contents, and remove the ligature. If the species under study does not have a crop, the ligature may be placed anterior to the proventriculus.

Various devices including pipe cleaners (Moore 1986, Orians 1966, Robertson 1973, Van Balen 1973, Walsh 1978, Willson 1966), metal bands (Kluyver 1961), plastic coated wire, string, heavy thread and enameled copper wire (see Johnson et al. 1980) have been used as ligatures. Previous studies conducted by personnel of The Institute of Wildlife and Environmental Toxicology (TIWET) have used pipe cleaners, commonly applied by a few experienced individuals.

There are inherent difficulties in using ligature devices for dietary analyses. Ligatures must be applied tightly enough to prevent food items from being swallowed. This is of special concern for smaller prey items, the loss of which may introduce bias in the diet analysis (Robertson 1973). Conversely, the bands must not be so tight as to cause mortality, reduce begging behavior (Moore 1986, Orians 1966), or cause nestlings to disgorge food items. Some researchers have noted that adults may react to the ligature and attempt to remove it rather than feed the nestlings, resulting in a decreased feeding rate (Robertson 1973, Willson 1966).

We undertook a toxicology field study during 1989 on study areas in eastern Washington and south-central Pennsylvania. Reproductive success in the European Starling (*Sturnus vulgaris*) was assessed using artificial nest boxes. Twelve test sites in each study area were selected and forty wooden nest boxes placed on each site to provide nesting habitat. We evaluated exposure of nestlings to the test material (an organophosphorus insecticide) through food items brought to the nest by adults, with food items collected using esophageal constrictions. The scope of the investigations necessitated use of numerous field personnel on each study, most of which had no prior experience in the use of ligatures.

Our initial attempts at esophageal constriction with pipe cleaners in eastern Washington resulted in mortalities or the food items being swallowed due to loose ligatures. The nap on the pipe cleaners made it difficult to assess the tightness of the ligature. Our success in obtaining samples without mortalities appeared to be related to the experience of the field personnel.

During the initial portion of the study in eastern Washington, we began experimenting with small, nylon, electrical cable-ties (10.2 cm black cable-ties, #45-104UVB, Gardner Bender Electrical, Inc., Milwaukee, Wisconsin) as ligatures. The flat portion of these strips of nylon are ridged along the top (outer) side and can be pulled through a slot in the "box" end that has opposing ridges that create the locking mechanism (Fig. 1). As the strip is pulled through the box, the ridges interlock permitting the resulting loop only to be tightened.

After our initial success in eastern Washington, the use of cable-ties was incorporated into another field study in western Washington. Our

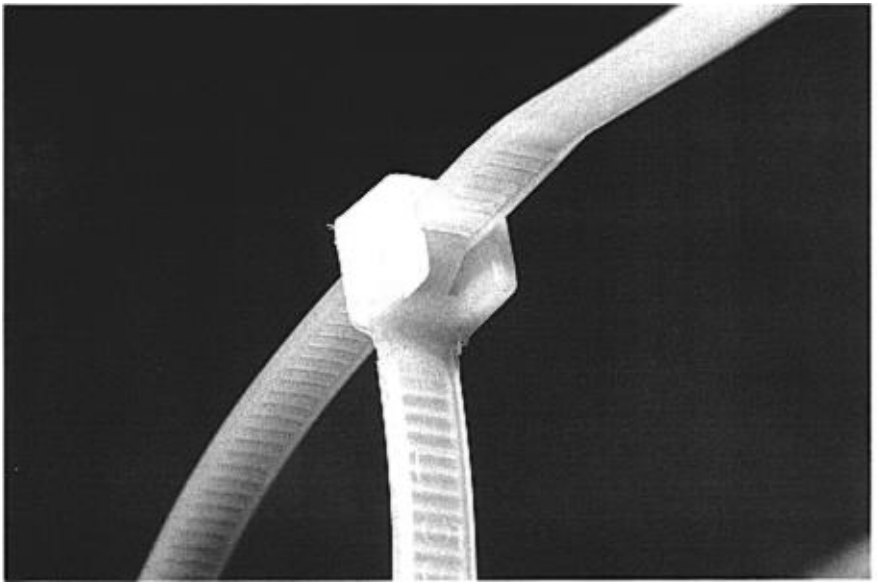

FIGURE 1. Close-up of an electrical cable-tie, illustrating the box mechanism and closely-spaced ridges on the band.

results from the research in eastern Washington and Pennsylvania indicated that cable-tie use increased the success rate of sample collection and decreased mortalities, as compared to pipe cleaners (Table 1).

We found that the primary benefit of using cable-ties as ligatures is the ease of application. This device is simple and fastens easily, an advantage for inexperienced individuals or when researchers are working alone. The ability to quickly fasten the ligatures reduced our handling of nestlings and the time we spent at the nest. Cable-ties were secure when fastened and applied uniform pressure around the neck, insuring that the nestling could not swallow its meal (Fig. 2). We evaluated

TABLE 1. Comparison of sampling success and mortalities using pipe cleaners and cable-ties as ligatures on nestling European Starlings.

		Successful samples		Mortalities	
	n[1]	#	%	#	%
Washington					
Pipe cleaners	26	5	19	7	27
Cable-ties	594	373	63	2	<1
Pennsylvania					
Pipe cleaners	314	101	32	2	<1

[1] Number of ligature attempts on nestlings.

FIGURE 2. Close-up photograph of an electrical cable-tie in place on the throat of a nestling European Starling (*Sturnus vulgaris*).

effectiveness in preventing swallowing of smaller food items by the presence, in the back of the throat, of the avian equivalent of "saliva." Our assumption was that if these fluids could not be swallowed by the nestling, neither could food items. In nearly every instance where a cable-tie was used but no food items were present, these fluids were found in the back of the throat, indicating the cable-tie was properly fastened and functioning. In a majority of the instances with pipe cleaners, however, these fluids were absent.

Cable-ties are available in a range of sizes (widths and lengths) allowing researchers to select an appropriate size for the species and age of nestlings studied. We found this size range to be of particular importance when working with the younger nestlings (e.g., <5 d). Finally, cable-ties were inexpensive and readily available at hardware, electrical or electronic stores, even in small towns in relatively remote areas.

Removal of cable-ties is relatively easy, but caution must be exercised. Cable-ties fitted closely with no space between the neck and the ligature, making it difficult to insert a cutting device. Our experience suggests that removal of the ligature is most easily done by cutting through the box on the cable-tie, thereby removing the locking mechanism (Fig. 3). Devices used to cut through the ligature successfully have included small electrician's cutters or large side-cutters. Side-cutters are wire cutters with the cutting edges flush on one side of the tool.

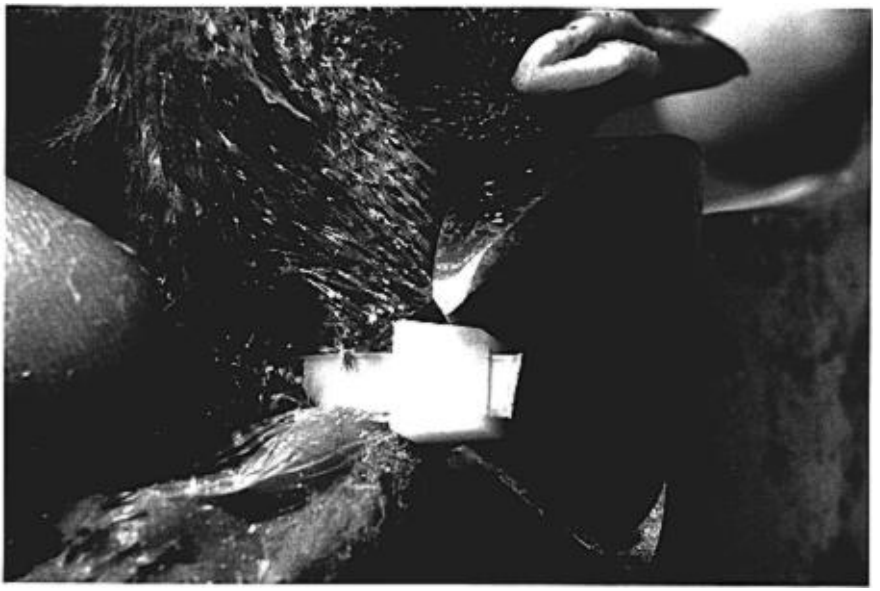

FIGURE 3. Close-up photograph of an electrical cable-tie and the placement of side-cutters to cut through the box mechanism.

As with any ligature method, care must be exercised when applying cable-ties to very young nestlings (e.g., 1–3 d of age). Nestlings have occasionally developed abrasions on the neck when using cable-ties. We suspect this problem resulted from improper application or removal. The potential for improper application and removal might be alleviated by using round cable-ties, sanding the edges of the cable-ties to reduce their sharpness, or coating the portion that will be around the neck with rubber.

One additional procedural caution should be mentioned. We observed that as nestlings approached fledging, the shafts of developing feathers tended to catch in the box mechanism as the ligature was fastened. When this catching occurred, it prevented the ligature from tightening properly, allowing the nestling to swallow. The only solution was to cut off the cable-tie and apply another.

On the basis of our collective experience during these research projects, we found cable-ties to be more effective than pipe cleaners in obtaining crop samples and minimizing mortalities, especially when used by inexperienced personnel. It suggests to us that the effectiveness of cable-ties under these types of study conditions warrants further investigation. In studies in which nestling diet is to be evaluated, cable-ties offer a rapid, easy method that reduces the time spent handling the nestlings, minimizes the time investigators spend in proximity to the nest, and may increase the potential of obtaining samples.

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