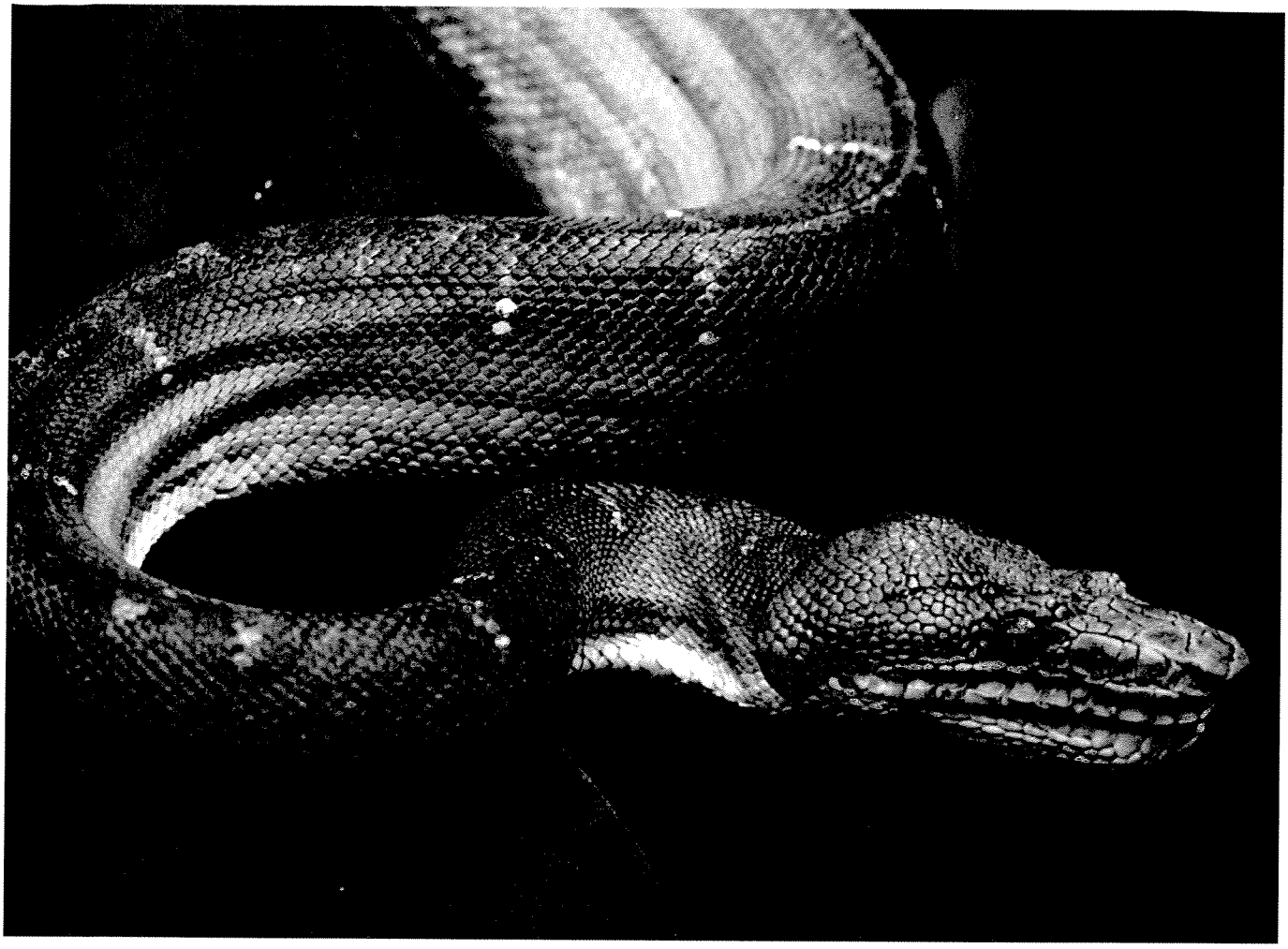

Do Erosion Control and Snakes Mesh?

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Table 1. Snake captures in erosion control blanket at each wetland restoration site.

Bay #	Captures	Species	Status
5	0		
124	1	Black Racer, *Coluber constrictor*	dead, partially decomposed
126	0		
131	1	Black Racer, *Coluber constrictor*	dead, recently
	1	Rat Snake, *Elaphe obsoleta*	dead, recently
	1	Water Snake, *Nerodia ?*	dead, partially decomposed
171	2	Black Racer, *Coluber constrictor*	dead, recently
5001	3	unknown	dead, complete skeletons
5011	0		
5016*	0		
5071	2	Black Racer, *Coluber constrictor*	alive, severe lacerations
	1	Corn Snake, *Elaphe guttata*	alive, severe lacerations
5092	0		
5128	0		
5135	0		
5184	2	unknown	dead, complete skeletons
5190	1	Black Racer, *Coluber constrictor*	dead, partially decomposed
	1	Eastern Hognose	alive, severe lacerations (fatal)
5204	1	Black Racer, *Coluber constrictor*	alive, released
5239	1	Black Racer, *Coluber constrictor*	dead, partially decomposed
	1	unknown	dead, complete skeleton

[§]Bay 5016 was flooded and could not be plugged until later that year, so no ECB was installed.

In the battle to curb soil erosion and sedimentation, numerous techniques and products for controlling erosion and sedimentation have been developed and are being implemented. Rolled erosion control products, such as temporary erosion control blankets and permanent turf reinforcement mats, represent one type of erosion control product that has been used extensively. The rolled products use stitching and net-like mesh fabrics made of various materials (plastic, nylon, twine, etc.) to hold materials (straw, coconut husk, jute, wood, polypropylene, etc.), which serve as an organic matrix to retain soil moisture, promote seed germination, and disperse erosion causing energy from raindrop impact and water runoff. Even though the rolled products have proven their value in erosion prevention and control, potential problems associated with their use were discovered on a project implemented to restore Carolina bay depressional wetlands in South Carolina. We found that the products are a hazard to snakes and possibly other wildlife and suggest the products need a smaller mesh size.

The U.S. Department of Energy's (DOE) Savannah River Site in west-central South Carolina contains approximately 350 Carolina bays. Nearly, two-thirds of the bays were degraded or destroyed prior to federal acquisition of the land. These isolated wetlands range from small ephemeral depressions to large permanent ponds of several hectares in size. They provide habitat to support a wide range of rare plant species and many vertebrates (birds, amphibians, reptiles, bats) (Sharitz, 2003). Historical impacts to the Carolina bays were primarily associated with agricultural activities. Bays were often drained, tilled, and planted to crops. The consequence was a loss in the wetland hydrologic cycle, the native wetland vegetation, and the associated wildlife. In an effort to restore these habitats, sixteen Carolina bays were identified as candidates for restoration.

Due to the small size of the restoration areas (from one and a half acre to six acres) and limited amount of fill material needed for the plug (approxiamately 10 m^3 per site) the U.S. Army Corps of Engineers issued a Nationwide Permit 27 for the activities. Specified within the permit was that best management practices were to be implemented to minimize erosion and migration of sediments off site. Practices listed in the permit included: hay bales, silt fences, rolled erosion control products, and vegetative cover. The rolled products seemed ideally suited for protecting the sites given that the ditch plugs were generally less than three feet in width and that one blanket could simply be rolled over the exposed soil that formed the plug. As such, two brands of erosion control blankets were used on these sites, one that contained a coconut/straw mix and another containing only coconut fiber. Both blankets were eight feet wide by 90 feet in length and contained an internal and external plastic netting with a mesh size of 10 mm^2 and 20 mm^2, respectively. In all, fifteen blankets were utilized for the project, one per wetland site.

Four months after the restoration activities were completed, Bay 5071 was visited and three live snakes—two black racers, *Coluber constrictor* and one corn snake, *Elaphe guttata*—were observed entangled in the blanket. The snakes were freed from the blanket by cutting through the plastic mesh using scissors, but all received sever lacerations from the plastic mesh. Later that day, a second site was visited (Bay 5204) and another live black racer was observed entangled in a blanket. Recognizing that a potential problem had arisen, all sites were visited the following day to survey for additional captures. Of the fifteen restoration sites visited, nine (60 percent) contained entangled snakes (Table 1). A total of 19 snakes were found in the 15 sites, which equates to 1.26 captures per blanket roll.

In addition to the species listed earlier, a rat snake (*Elaphe obsolete*), water snake

(*Nerodia* sp.), and eastern hognose (*Heterodon platyrhinos*) were identified in the plastic mesh. Snake entanglement has been reported in bird netting and to a lesser extent in erosion control blankets (Stuart et al., 2001), but the magnitude observed in these sites was dramatic considering the small amount of material used and the short timeframe that the mesh was employed on the ground. As a consequence, the blankets were removed from the sites and replaced with wheat straw mulch.

Black racers were the most common of the 19 snakes caught in the blankets used in the Carolina bay restoration project. Black racers are known to exhibit powerful, fast undulatory movement and can twist until the tail breaks away from the body (Greene, 1997). As this twisting behavior is a common escape mechanism for this species, it is likely that once caught by the mesh, the animal began to twist while attempting to escape. Unfortunately the twisting behavior would result in the snake being more firmly entrapped by several squares of the mesh, until the snake is virtually immobile. As the mesh tightens around the snake's body, the plastic cuts into the skin resulting in the severe lacerations we observed. Fourteen of the 19 trapped snakes died as a result of being trapped, either due to the lacerations received, to overheating, or to being unable to escape from predators including fire ants. We have no way of determining the exact cause of death for 14 animals. All deaths were precipitated, however, by the entrapment of the erosion control blanket plastic mesh. The three identified species are similar in body width to the opening of the 20 mm^2 mesh of the blanket.

While the deaths of common snakes is certainly not an objective of any responsible land manager, the fact that they occur may not be considered a tragic accident. However, the use of these blankets in areas containing federally or state threatened and/or endangered snake species could result in an outcome that results in the land or project manager facing criminal charges. Table 2 outlines areas within the United States where federally threatened and endangered snake species exist and where installation of blankets may not be warranted. In addition, many states have protection for animals on the state threatened and endangered species, which are not threatened nationally. In these zones, the use of blankets may not be totally restricted, but efforts to use products such as permanent turf reinforcement mats that contain a very small mesh size (< 5 mm^2) is recommended.

Table 2. Threatened and endangered snakes in the United States.

Common Name	Scientific Name	Range†	Status‡
Atlantic salt marsh snake	*Nerodia clarkii taeniata*	FL (coastal areas of Volusin, Brevard and Indian River counties)	T
Concho water snake	*Nerodia paucimaculata*	TX (Concho and Colorado river basins of the Rolling Plains)	T
Copperbelly water snake	*Nerodia erythrogaster neglecta*	IL, IN, MI, OH, KY (IN north of 40° N. Lat.)	T
Eastern indigo snake	*Drymarchon corais couperi*	AL, FL, GA, MS, SC (entire range)	T
Giant garter snake	*Thamnophis gigas*	CA (central Sacramento Valley area; San Joaquin Valley)	T
Lake Erie water snake	*Nerodia sipedon insularum*	OH (shorelines of islands in western Lake Erie)	T
New Mexico ridge-nose rattlesnake	*Crotalus willardi obscurus*	AZ, NM (NM)	T
San Francisco garter snake	*Thamnophis sirtalis tetrataenia*	CA (San Mateo county, CA)	E
Whipsnake (striped racer), Alameda	*Masticophis lateralis euryxanthus*	CA (Alameda and Contra Costa counties, CA)	T

†Historic range (area of concern)

‡T = threatened; E = endangered

Suggestions

Soil erosion control management is intended to lessen the impacts of physical weathering of the Earth's surface and thereby improve soil health, water quality, water quantity, and the overall health of the ecosystem. Rolled erosion control products are used extensively for this purpose and have proven their usefulness in construction sites across the United States. However, our findings indicate that they pose a potential hazard to snakes and possibly to other wildlife that may get entangled in the plastic mesh that holds the material together.

From an ecosystem health standpoint, we feel that these products are not suitable. It's not our intent to suggest that these products be prohibited for use because of this finding; however, we do suggest that manufacturers of these products consider using a smaller mesh size in their process and that discretion is used when placing these materials in sensitive areas where snakes are common.

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