Bat World Sanctuary
Position Statement on Banding Insectivorous Bats

Bat World Sanctuary (BWS) recognizes the need for marking individual bats in the wild for some research purposes, especially for conservation efforts and wildlife management. Such work is important, especially with respect to roost/hibernacula use and migration. A variety of marking techniques have been used over the years, with varying degrees of success. Whatever marking methods are utilized should be carefully evaluated regarding any potential for harming bats. It is the Bat World position that marking methods that have a strong likelihood of adversely impacting individual bats should not be used.

Leg banding was a marking technique used on bats by researchers as early as 1921. The metal bands used were the same type as those used on birds and did not take into consideration the morphological differences between bats and birds – most importantly the presence of the flight membranes connected to a bat's legs (Allen 1921).

Around 1934, researchers began attaching metal bands to a bat's forearm instead of the leg (Eisentraut 1934 as cited by Griffin 1936; Trapido and Crowe 1946). This method of marking bats was widely used and it is estimated that by 1957 nearly 200,000 had been banded (Hitchcock 1957). Concerns regarding possible injury due to banding were noted early on. Beer (1955) stated:

> "All of the bands except those used by Elder and Rysgaard were placed on the wing and may have been the cause of some mortality."

Hitchcock (1957) asked researchers who worked with bats in the field for their observations on banded bats. Following are a few of the responses he received.

> "Two of nine bats, banded nearly seven weeks ago and kept in captivity, show swelling of the same forearm and bleeding in one case...An unmeasured but large percentage of field recoveries have been in similar condition, and many numbers were illegible from being chewed."

> "…an inspection of about 100 preserved specimens which were sacrificed because of the highly inflamed condition of the arm around the band revealed that in over half these specimens there was an accumulation of bat feces, loose hair, and body oil under the band, filling in the space between bone and band."

> "In Yucatan we have banded a colony of more than 500 specimens of *Tadarida yucatanica*, many of which were recovered afterwards by tourists and members of the maintenance personnel at the particular spot where the bats were banded, in a very poor condition."

In a letter to Hitchcock, Richard B. Davis of John Hopkins University notes that he:

> "…examined 190 *Tadarida mexicana* one month after they had been banded. Of these, 86 showed no irritation or swelling; 104 were injured. Of the latter group, 33 were so badly injured that Davis killed them" (Hitchcock 1957).

From 1956 to 1959 Herreid et al. (1960) conducted a study to look at the effect of metal bands on Mexican free-tailed bats. They indicated that:

> "…during the progress of this work, it became apparent that considerable injury was caused by the use of the bird band." (Herreid et al. 1960).

They subsequently decided to add to their study specially modified bat bands that had:

> "…the corners of the front edges somewhat rounded off and a small lip turned back at each end so that these broad surfaces rather than the rough band edges make contact with the wing membrane." (Herreid et al. 1960).

They banded bats with one type of band or the other, released them, and recaptured them over the course of their study to quantify the level of injuries caused by the bands (Herreid et al 1960). They discovered that although the specially designed bat band was

slower to cause serious injury, over time both types of bands caused serious and similar levels of injuries to bats, with typically less than about 40% of those bats recovered later in the study being qualified as "good" (Herreid et al. 1960). They ended their paper with a comment indicating their hope that further modifications would be made to bands to reduce the injury to bats (Herreid et al. 1960).

Perry and Beckett (1966) examined the effects of forearm banding on neonatal Mexican free-tailed bats and they found serious damage to the skeletons of growing and developing bats. Approximately 10,000 neonatal bats had been banded in this manner (Perry and Beckett 1966).

In the 1950s and 1960s, it was estimated that over 430,000 Mexican Free-tailed bats were banded in Mexico, Arizona, Texas, Oklahoma, and New Mexico alone (Gary McCracken, personal communication, as cited by Lollar and Schmidt-French 2002). Unfortunately, very few of these bats were every recovered by researchers (Gary McCracken, personal communication, as cited by Lollar and Schmidt-French 2002).

Despite serious concerns regarding bat banding, use of metal bands on bats has continued to the present day. Following long-term usage of two types of bands – the metal split ring bird band and the metal lipped/flanged bat band – researchers analyzed recapture information on bats in Australia, scoring frequency and seriousness of banding injuries (Baker et al 2001). They ultimately concluded that:

> "Despite evidence to the contrary, the issue of band-related injury in bats has largely been ignored by bat researchers, who have tended to believe that the problem is either restricted to a few species, related to poor banding technique or mainly caused by the use of bird bands. It is widely believed that flanged bat bands are superior to standard bird bands, and only a few authors have considered bird bands to be preferable. Our results clearly show that both bird bands and bat bands can cause serious injuries to bats, and the problem occurs in most species examined."

They also used their data to estimate annual survival rates of banded bats, and their estimates ranged from a survival rate of 0.19 to 0.75, depending on species and type of band. In light of the wide scale of their study (over 6,000 banded bat recaptures from 17 different species), their conclusions must not be taken lightly. The Australian Bird and Bat Banding Scheme (2007) now has the following statement on their website:

> "In the process of revising the recommended band sizes for all Australian bat species we have found that the bands used on a number of Microchiropteran species are causing high rates of band injury. Based on these injury rates we are not prepared to approve any new permits for the banding of Microchiropteran bats and are, in fact, considering a moratorium on the banding of all members of the families Vespertilionidae, Emballonuridae and Molossidae."

These and other reports suggest that a great many bats are harmed by the use of metal bands. For this reason, Bat World Sanctuary opposes the use of metal bands on bats and strongly encourages exploration and examination of other marking techniques to further conservation and research efforts.

Although the first bird bands were made of metal, plastic bands were later developed and also used on bats (Barclay and Bell 1988). In early 1997, eight Mexican free-tailed bats banded with unmodified plastic split ring bands were recovered and seven of these bats had injuries resulting from those bands (Brian Keeley, personal communication as cited by Lollar and Schmidt-French 2002). Twenty Mexican free-tailed bats in at a zoo were also fitted with unmodified plastic bands, and 15 of them ultimately suffered injuries (Lollar and Schmidt-French). If they are to be used on bats, it is recommended that plastic split ring bands first be modified by filing to make the gap wider and the edges smoother for a proper and less abrasive fit (Lollar and Schmidt-French 2002). It is possible that these bands (when modified) are not as harmful as the more widely used metal bands, but further research and study must be undertaken before drawing such a conclusion or recommending them for wider use.

More recently, a bat rehabilitator in Africa was permitted to release bats on the condition they be banded prior to release. The bats were housed for 5 weeks post banding. Of 46 bats banded, 18 presented with significant band-caused injuries (39%) and 4 of those subsequently died. Had the remaining 14 not received medical intervention, they too would have died. (Dickson, pers. comm. 2007).

Alternative methods for marking bats do exist and have been utilized by various researchers. Tattooing as a method of marking bats was used as early as 1932 (Griffin 1934). Dr. Griffin tattooed identifying numbers on the membrane of bats' outstretched

wings, but soon abandoned this practice for the ease and speed of aluminum bands (Griffin 1934). Amanda Lollar, Founder and President of Bat World Sanctuary, has been tattooing the ears of hand-raised Mexican free-tailed bats (*Tadarida brasiliensis*) prior to release. The orphaned pups are obtained from a wild colony at Bat World's wild sanctuary. A nonreleasable adult bat from this colony was also tattooed in 1996 and maintained the tattoo for 10 years before dying of natural causes. In 2006, a tattooed female was found approximately 400 miles away five years after release. In July of 2010, a tattooed adult female was found at Bat World's wild sanctuary. Approximately two years prior, this bat was found orphaned at the wild sanctuary, hand-raised, tattooed and released. The bat had migrated south and returned to her roost to give birth within her original nursery colony. Due to the evident success of tattooing the ears insectivorous bats, BWS believes the only current hurdle to widespread use is ease of application in the field, which is something that could be increased with tools designed specifically for bats.

Bonaccorso and Smythe (1972) punch-marked numbers into bats' wing membranes and found no occurrence of marking-related injury. Marking was accomplished at the respectable rate of one bat per minute (Bonaccorso and Smythe 1972). Although long-term duration of this marking technique was not determined, the maximum length of time between marking and reexamination of the mark was 48 days (Bonaccorso and Smythe 1972). This marking technique may merit further examination.

Sherwin et al. (2002) used freeze branding to permanently mark bats dorsally. After branding, the fur grew back white within about 36 days, allowing the bat to be easily identified (Sherwin et al. 2002). However, the authors did give the following precautions.

> "Brands should be made as inconspicuous as possible while still remaining visible to the researcher, thus reducing increased risk of predation due to alteration of cryptic coloration. The necessity of clipping the fur dictates that animals not be marked during or immediately prior to periods of hibernation. This technique should not be used on bats that are federally (USA) threatened or endangered until long-term effects of branding are known. Freeze-branding bats is most effective for long-term studies as it can take up to 2 months for the brand to appear."

Necklaces have also been used by some researchers for bat identification (Barclay and Bell 1988). Properly fitting such a device, especially on any species of bat that undergoes large fluctuations in weight throughout the year, would be particularly problematic.

For short-term identification and tracking of bats, small radio transmitters have been used since at least the early 1980s (Wilkinson and Bradbury 1988). Transmitters are usually attached with adhesive that allows it to fall off within days to weeks (Wilkinson and Bradbury 1988). So that flight is not significantly impaired, transmitters should weigh less than 5% of the bat's body mass (Barclay and Bell 1988).
PIT (passive integrated transponder) tags are microchips that are implanted subdermally and which can be scanned to identify individual bats when they have been captured (Neubaum et al. 2005). Indiana State University has been PIT tagging big brown bats since the early 1990s at a roosting site in Terre Haute, Indiana (John O. Whitaker, Jr. personal communication). Before wide adoption of such a marking technique, effects of PIT tags on different species of bats (especially smaller ones) should be examined. The size of needle used to implant the microchip may also necessitate local anesthesia during the application process. Further, veterinary review of procedures should be undertaken as the large size of the implantation needle presents a significant route of infection. While it is impossible to guarantee sterile field conditions, veterinary review will ensure that the process is as clean as possible. Because the relative size of the chips and implant devices can cause pain and long term damage, development of smaller PIT tags should be encouraged.

Molecular techniques are increasingly being used as technology improves and becomes more readily available to researchers. Population size and sex ratio have been estimated from fecal samples (Kohn et al 1999). In the same study, Kohn and associates indicate they were able to:

> "…show that home range use, paternity and kinship can be inferred from the distribution and relatedness patterns of fecal genotypes" (Kohn et al 1999).

Tissue samples (such as blood or wing tissue) can also be used in identifying and establishing paternity/kinship of individual bats (McCracken and Wilkinson 1988). However, tissue collection such as wing punches should be limited to minimize length of handling, and care should be taken to minimize sample type collection, that is, consider whether it is in the animal's best interest to take double wing punches and hair when the same animal is also to be banded and radio-tagged.

Bats have been known to die after exhibiting capture-myopathy-like symptoms (Sturges, pers. comm.). Overly stressed bats have also aborted almost full-term fetuses several hours after a stress event. It is imperative to limit duration and amount of restraint

and handling, particularly of pregnant females.
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