

Use of Chiroptera in Multi-Species Exhibits

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Zoos have been using mixed-species exhibits for many years; either to develop an exhibit based on a geographic theme or to help alleviate a shortage of space. With the evolution of exhibits to incorporate species natural habitats, animal managers are utilizing the mixed-species approach more regularly.

Although mixed and multi species exhibits containing primates, ungulates, avian and reptile species are common; bat species have not been attempted as frequently. Due to the bat's ability to use specific areas within an exhibit, such as roosting in trees and clinging to cave walls, this order should be a very good candidate for multi-species exhibition. The simple fact that a bat is a flying mammal that normally will not go to the ground can open them to being mixed with many animals. Typically little or no interaction would occur with the other species unless initiated by the bats themselves. We feel that by developing a list of recommendations, facilities may be more likely to attempt to use bats in mixed species exhibits. This in turn may help to educate the public, offer a more dramatic exhibit and possibly free up space in facilities with surplus bats in their collection.

A survey was developed to determine the number of multi-species exhibits using Chiropterans. The survey asked which species had been mixed with bats and whether or not the exhibit was successful. We received responses from 16 facilities on 21 exhibits. When creating a multi-species display 28% of the institutions noted that developing a "natural exhibit" around a geographical theme was their primary reason. Another 28% noted a need for housing space. Other factors included space utilization in the exhibit and activity levels of the various species.

The positive aspects of mixed species exhibits have been noted by Thomas and Maruska (1996) as:

- 1) The same physical facility can be used for multiple species, thus reducing the necessity for and expense of separate enclosures for each individual species.
- 2) Combining species in the same enclosure presents a more interesting and educational display to the public. Mixed-species exhibits provide an opportunity for direct comparisons of the sizes and adaptations of different species, and often the movements and dynamics of the different species together create a much more appealing, exciting exhibit.
- 3) The combination of multiple species within a single enclosure can provide a stimulus to the animals through their contact with each other. The level of activity increases, and as long as the activity is not antagonistic, this can have a positive effect on the physical and mental health of animals.

Due to their nocturnal nature, most bat exhibits in zoological institutions have been developed around the use of a nocturnal theme utilizing a reversed light cycle. Although the public gets a view of the bat's natural behavior they rarely get a very good look at the bats themselves. Many visitors will quickly move on to the next exhibit if they cannot view the animal clearly, and once the exhibit is

passed, the graphics and any conservation message they offer is missed as well. Offering a diurnal exhibit for bats can greatly enhance our ability to grab the visitor's attention. We can hold them at the exhibit long enough to get a good look at the animals, to find them attractive or even more unattractive than they had originally imagined. This in itself affords the institution the time to have their graphics viewed and hopefully pass along their conservation message. The fact that bats are nocturnal greatly increases the ability of the public to view them, as they will normally roost quietly throughout the daylight hours.

A common complaint among many visitors is that "the animals are not doing anything." Utilizing bats in a multi-species exhibit with diurnal animals may help to alleviate this. Exhibits that house both nocturnal and diurnal species, as well as species that will utilize different areas of their habitat, offers an opportunity to create an educational message. The diversity of various habitats, how the species interact with each other and the tools they have developed to keep from competing for food sources within these habitats can all be discussed.

Displaying bats in diurnal exhibits opens a whole new realm of possibilities. Fifty-six percent of the survey respondents indicated their mixed displays were diurnal or used natural outdoor lighting.

Bats have been mixed with a wide variety of species. The data from all survey respondents has been compiled into three charts, figures 1, 2, and 3. Twenty-two species of non-chiropteran mammals were listed as being exhibited with bats as well as 12 chiropteran species, 21 avian species and 6 species of reptiles. Bats have also been successfully housed in large multi-species rain forest habitats where they are free to fly among the other exhibits. With the exception of interactions with gibbons, binturongs and armadillos, there were no major difficulties. The problems concerning the armadillos were relatively minor, but should be considered. Armadillos were found to have harmed or eaten any newborn bats that were dropped to the ground. Gibbons were observed harassing the bats when they flew low enough for the gibbons to reach, again just a minor problem. The binturongs presented a more serious problem. There were considerable interactions when both the bats and the binturongs were active and the binturong killed a number of bats. The belief in this instance was that some of the bats were overweight and may have had difficulty flying when approached by the binturongs. This is an integration that should be considered carefully before introducing these animals to an exhibit.

The only other concerns noted from the survey were related to diet. Providing enough food for all species solved most of these concerns. Some facilities had to watch that their bats did not get too much food and become overweight.

Since one of the goals of a zoological institution is to educate the public, we need to grab their attention, hold it long enough for the visitor to view the species and offer them the opportunity to enjoy the animal itself. Only at this point will the visitor take the time to read the adjacent graphics and learn about the animals they are seeing. By utilizing mixed-species display we maximize the number of animals that can be exhibited and provide a more natural, entertaining display. Bats should be a natural choice for many mixed-species exhibits as they rarely compete for space and provide activity at different times of the day.

FIGURE 1: Chiroptera with non-chiropteran Mammals

<i>Pteropus rodricensis</i> Rodriguez Flying Fox	Giant Asian squirrel Small clawed otter <i>Amblonyx cinereus</i> Bay Duiker <i>Cephalophus dorsalis</i> Prevost squirrel <i>Callosciurus prevostii</i> Matchies Tree Kangaroo <i>Dendrolagus matschieri</i> Northern Lesser Bushbaby <i>Galago senegalensis</i> Brush tailed Bettong <i>Bettongia penicillata</i> Brush-tailed porcupine <i>Atherurus africanus</i> Malayan Tapir <i>Tapirus indicus</i> White-handed gibbon <i>Hylobates lar</i> *Binturong <i>Arctictis binturong</i>
<i>Pteropus giganteus</i> Indian Flying Fox	Acouchi <i>Myoprocta acouchy</i> Malayan Tapir <i>Tapirus indicus</i> Ring-tailed lemur <i>Lemur catta</i> Indian Crested porcupine <i>Hystrix indica</i> Prevost squirrel <i>Callosciurus prevostii</i> Ruffed lemur <i>Varecia variegata</i> White-handed gibbon <i>Hylobates lar</i> Reeve's Muntjac <i>Muntiacus reevesi</i>
<i>Pteropus hypomelanus</i> Island Flying Fox	Greater Malayan Chevrotain <i>Traulus napu</i> Northern Lesser Bushbaby <i>Galago senegalensis</i>
<i>Eidolon helvum</i> Straw-colored Fruit Bat	African crested porcupine <i>Hystrix africaeaustralis</i> Rock hyrax <i>Procavia capensis</i>
<i>Rousettus aegyptiacus</i> Egyptian Fruit Bat	Nine-banded Armadillo <i>Dasypus novemcinctus</i> Northern Lesser Bushbaby <i>Galago senegalensis</i>
<i>Rousettus lanosus</i> Ruwenzori Long-haired Fruit Bat	African crested porcupine <i>Hystrix africaeaustralis</i> Rock hyrax <i>Procavia capensis</i>
<i>Artibeus jamaicensis</i> Jamaican Fruit-eating Bat	Two-toed sloth <i>Choloepus sp.</i> Nine-banded Armadillo <i>Dasypus novemcinctus</i> Striped Skunk <i>Mephitis mephitis</i> Northern Lesser Bushbaby <i>Galago senegalensis</i>
<i>Carollia perspicillata</i> Seba's short-tailed Fruit Bat	Northern Lesser Bushbaby <i>Galago senegalensis</i> Two-toed sloth <i>Choloepus sp.</i> Nine-banded Armadillo <i>Dasypus novemcinctus</i> Striped Skunk <i>Mephitis mephitis</i>

* Binturongs were the only species where serious problems.

Figure 2: Chiroptera with Avifauna and/or Herpetofauna

<i>Pteropus rodricensis</i> Rodriguez Flying Fox	Boobook Owl <i>Ninox novaeseelandiae</i> sp. Red-billed hornbill <i>Tockus erythrorhynchus</i> *Jungle World	
<i>Pteropus giganteus</i> Indian Flying Fox	Crested wood partridge <i>Rollulus rouloul</i> Bali Mynah <i>Leucospar rothschildi</i> *Sedgwick County *Leid Jungle	Water dragon <i>Physignathus cocincinus</i>
<i>Eidolon helvum</i> Straw-colored fruit bat	Grey-winged trumpeters <i>Psophia</i> sp. White-vented bulbul <i>Pycnonotus barbatus</i> Lilac-breasted roller <i>Coracias caudata</i> Gold breasted starling <i>Cosmopsarus regius</i> Red and Yellow barbets <i>Trachyphonus erythrocephalus</i> Speckled mousebirds <i>Colius striatus</i> Abdim stork <i>Ciconia abdmii</i> Green Heron <i>Butorides virescens</i> Hottentot teal <i>Anas punctata</i> Black crane <i>Limnocolax flavirostra</i> Livingstone's turaco <i>Tauraco corythaix livingstoni</i> Mandarin duck <i>Aix galericulata</i> Kenya-crested guineafowl <i>Guttera pucherani</i> White-bellied go-away bird <i>Corythaixoides leucogaster</i> White-crowned robin chat <i>Cossypha albicapilla</i>	Red-footed tortoise <i>Geochelone carbonaria</i> African Mud turtle <i>Pelusios subniger subniger</i> Leopard tortoise <i>Geochelone pardalis</i> Bell's Hingeback tortoise <i>Kinixys belliana</i>
<i>Rousettus aegypticus</i> Egyptian Fruit Bat	*Leid Jungle	
<i>Rousettus lanosus</i> Ruwenzori long-haired Fruit Bat	Lilac-breasted roller Livingstone's turaco White-vented bulbul Kenya-crested guineafowl	Bell's Hingeback tortoise
<i>Carollia perspicillata</i> Seba's Short-tailed Fruit Bat	Hanging parrots <i>Loriculus</i> sp. Black-cheeked lovebirds <i>Agapronis nigrigenis</i> White-vented bulbul Kenya-crested guineafowl	
<i>Glossophaga soricina</i> Palla's long-tongued bat	*Biodome	

* Large free flight mixed species exhibit

FIGURE 3: Chiroptera Housed with Chiroptera

<i>Pteropus vampyrus</i> Large Flying Fox	<i>Pteropus rodricensis</i> Rodriguez Flying Fox
<i>Pteropus rodricensis</i> Rodriguez Flying Fox	<i>P. vampyrus</i> Large Flying Fox <i>Artibeus jamaicensis</i> Jamaican Fruit Bat <i>Carrollia perspicillata</i> Short-tailed Fruit Bat <i>Rousettus aegypticus</i> Egyptian Fruit Bat <i>Eidolon helvum</i> Straw-colored Fruit Bat
<i>Pteropus giganteus</i> Indian Flying Fox	<i>Artibeus jamaicensis</i> Jamaican Fruit Bat <i>Rousettus aegypticus</i> Egyptian Fruit Bat <i>Carrollia perspicillata</i> Short-tailed Fruit Bat
<i>Eidolon helvum</i> Straw-colored fruit bat	<i>Epomophorus wahlbergi</i> Wahlberg's Bat <i>Pteropus rodricensis</i> Rodriguez Flying Fox <i>Rousettus lanosis</i> Ruwenzori Long-haired Fruit Bat <i>Rousettus aegypticus</i> Egyptian Fruit Bat <i>Artibeus jamaicensis</i> Jamaican Fruit Bat
<i>Rousettus aegypticus</i> Egyptian Fruit Bat	<i>Pteropus giganteus</i> Indian Flying Fox <i>Carrollia perspicillata</i> Short-tailed Fruit Bat <i>Noctilio leporinus</i> Greater Bulldog Bat <i>Artibeus jamaicensis</i> Jamaican Fruit Bat <i>Pteropus rodricensis</i> Rodriguez Flying Fox <i>Eidolon helvum</i> Straw-colored Fruit Bat <i>Epomophorus wahlbergi</i> Wahlberg's Bat
<i>Rousettus lanosus-</i> Ruwenzori Long-haired Fruit Bat	<i>Eidolon helvum</i> Straw-colored Fruit Bat
<i>Artibeus jamaicensis</i> Jamaican Fruit-eating Bat	<i>Pteropus giganteus</i> Indian Flying Fox <i>Carrollia perspicillata</i> Short-tailed Fruit Bat <i>Noctilio leporinus</i> Greater Bulldog Bat <i>Rousettus aegypticus</i> Egyptian Fruit Bat <i>Pteropus rodricensis</i> Rodriguez Flying Fox <i>Eidolon helvum</i> Straw-colored Fruit Bat <i>Epomophorus wahlbergi</i> Wahlberg's Bat <i>Glossophaga soricina</i> Palla's Long-tongued Bat <i>Anoura geoffroyi</i> Geoffrey's Tailless Bat
<i>Carollia perspicillata</i> Seba's Short-tailed Fruit Bat	<i>Glossophaga soricina</i> Palla's Long-tongued Bat <i>Anoura geoffroyi</i> Geoffrey's Tailless Bat <i>Pteropus rodricensis</i> Rodriguez Flying Fox <i>Noctilio leporinus</i> Greater Bulldog Bat <i>Artibeus jamaicensis</i> Jamaican Fruit Bat <i>Rousettus aegypticus</i> Egyptian Fruit Bat <i>Pteropus giganteus</i> Indian Flying Fox