

**VOCAL IMITATION IN AFRICAN SAVANNAH
ELEPHANTS (*LOXODONTA AFRICANA*)**

**ZVOČNO POSNEMANJE PRI AFRIŠKIH SLONIH
(*LOXODONTA AFRICANA*)**

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ABSTRACT

Vocal imitation in African Savannah Elephants (*Loxodonta africana*)

There are a few mammalian species that can modify their vocalizations in response to auditory experience. We describe two examples of vocal imitation by African Savannah Elephants (*Loxodonta africana*), a terrestrial mammal that lives in a multitiered fission-fusion society. The first case of vocal imitation involves Mlaika, an adolescent female African Elephant who lived in a semi-captive group of orphaned elephants in the Tsavo National Park, Kenya. Trucks were audible from a highway 3 km from the night stockade. Mlaika emitted truck-like sounds for several hours after sunset, the optimal time for the transmission of low frequency sound in African savannahs. The second case involves Calimero, an adult male African Elephant who spent 18 years living with two female Asian Elephants (*Elephas maximus*) at the Rome zoo. Calimero imitated the chirping sounds typically produced by Asian Elephants, though not by African Elephants. Our findings favour a role for vocal imitation that has already been proposed for primates, birds, bats and marine mammals: it is a useful form of acoustic communication that helps to maintain individual-specific bonds within social changing groupings.

Key words: Vocal learning, social bonds, fluid societies.

IZVLEČEK

Zvočno posnemanje pri afriških slonih (*Loxodonta africana*)

Poznamo le malo vrst sesalcev, ki lahko spreminjajo svoje oglašanje v zvezi s slušnimi zaznavami. Avtorji opisujejo zvočno posnemanje pri afriških slonih (*Loxodonta africana*), kopenskih sesalcih, ki živijo v odprti hierarhični združbi. Prvi primer se nanaša na slonico Mlaika, mladoletno žival, ki je živel v poludomačeni skupini osirotelih slonov v Kenijskem narodnem parku Tsavo. Tovornjake je bilo slišati z avtoceste oddaljene 3 km od ograde s sloni. Mlaika je oddajala po več ur skupaj tovornjakom podobne glasove zvečer po sončnem zahodu, ko so najboljše razmere za širjenje nizkofrekvenčnih glasov v afriških savanah. Drugi primer je Kalimero, odrasel samec afriškega slona, ki je 18 let prebil z indijskima slonicama (*Elephas maximus*) v Rimskem živalskem vrtu. Kalimero je oddajal cvrčee glasove, ki so značilni za indijske slone, niso pa običajni za afriške. Naše ugotovitve kažejo na pomen zvočnega posnemanja, ki so ga že ugotavljali pri primatih, ptičih, netopirjih in morskih sesalcih. To je, da koristna oblika akustičnega sporazumevanja, ki pomaga vzdrževati vezi med posameznimi osebkami v spremenljivih živalskih združbah.

Ključne besede: zvočno posnemanje, družbene vezi, spremenljive združbe.

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Vocal learning and in particular imitation in non-human mammals has received a growing research attention in the recent years and two forms of vocal learning have been distinguished, contextual learning and production learning (JANIC & SLATER 2000). Contextual learning affects the behavioural context of a signals usage and its serial positioning, while production learning refers to sounds that are themselves modified based on auditory experience with other individuals or models (JANIC & SLATER 2000). While there is good evidence that terrestrial mammals learn to comprehend and use their calls correctly (SEYFARTH & CHENEY 1997), there are only few mammalian species that can modify their vocalizations in response to auditory experience (JANIC & SLATER 1997). Some marine mammals for example use vocal imitation for reproductive advertisement as birds sometimes do. Here we describe two examples of vocal imitation by African Savannah Elephants (*Loxodonta africana*) a terrestrial mammal that lives in a complex fission-fusion society (MOSS & POOLE 1983). Elephants are capable of long distance vocal recognition of conspecifics (MCCOMB et al. 2003) and their vocal repertoire is both extensive and highly variable (POOLE et al. 1988, POOLE 1994, POOLE in prep, PAYNE 2003).

In the first case, we recorded imitations of truck sounds produced by Mlaika, a ten-year old adolescent female African Elephant living in a semi-captive group of orphaned elephants in Tsavo National Park, Kenya. Trucks (Fig. 1A) were sometimes audible from Mlaikas night stockade which lay three kilometers from the Nairobi-Mombasa highway. Mlaika emitted truck-like sounds (Fig. 1B) for several hours after sunset, the optimal time for the transmission of low-frequency sound in African savannahs (GARSTANG et al. 1995). For the analyses we used 10 randomly selected calls of each individual of the entire data set consisting of data from nine adult and adolescent female African Elephants, two adult male African Elephants, two female African calves, four male African calves, Mlaika's normal vocalizations, Mlaika's truck-like calls and truck noise. Comparisons of duration and of minimum and maximum fundamental frequency show that Mlaika's truck-like calls differ significantly from normal African calls (Fig. 2, Man-Whitney *U*-test, $P > 0.002$) and do not differ significantly from the truck sounds (Fig. 2, Man-Whitney *U*-test, $P > 0.1$). The individual means for the three acoustic parameters of these calls also show that Mlaika's truck like calls differ from normal calls of African Elephants (POOLE et al. 1988) and are similar to the recorded truck sounds (Fig. 3a).

The second case of imitation by an African Elephant involves the chirping sounds (MCKAY 1973) typically produced by Asian Elephants (*Elephas maximus*) though not by African Elephants. Calimero, a 23 year old male African Elephant living in captivity, spend 18 years with two female Asian Elephants. The spectrogram in Fig. 1C shows a typical series of chirps from one of the Asian Elephants he lived with and Fig. 1D shows the similar chirp-like calls made by Calimero. For the analyses we used again 10 randomly selected calls of each individual of the entire data set consisting of data from nine adult and adolescent female African Elephants, two adult male African Elephants, two female African calves, four male African calves, nine adult female Asian Elephants and Calimero's chirp-like calls. Calimero's chirp-like calls do not significantly differ in duration from the chirping calls of female of Asian Elephants ($P > 0.46$). They do differ in all parameters from mean adult, adolescent and calf African Elephant calls ($P > 0.002$, Fig. 2).

Multidimensional scaling using duration, minimum and maximum fundamental frequency confirms that Calimero's chirp-like calls differ from normal calls of African Elephants and are similar to the chirps of female Asian Elephants (Fig. 3b).

The finding, that an African Elephant matched the calls of Asian Elephants with whom he lived follows a pattern commonly seen in species that are capable of vocal learning, in which calls converge as the animals form social bonds (TYACK 2003). Vocal learning enables a flexible and open communication system in which animals may learn to imitate signals that are not typical of the species, as demonstrated by the elephant that imitated trucks. Our findings favour a role for vocal imitation that has already been proposed for primates, birds, bats and marine mammals: it is a useful form of acoustic communication that helps to maintain individual-specific bonds within social changing groupings (TYACK 2003). It strengthens the idea that there is a primary selection pressure for vocal learning that involves the communicative demands of maintaining social relationships in fluid societies.

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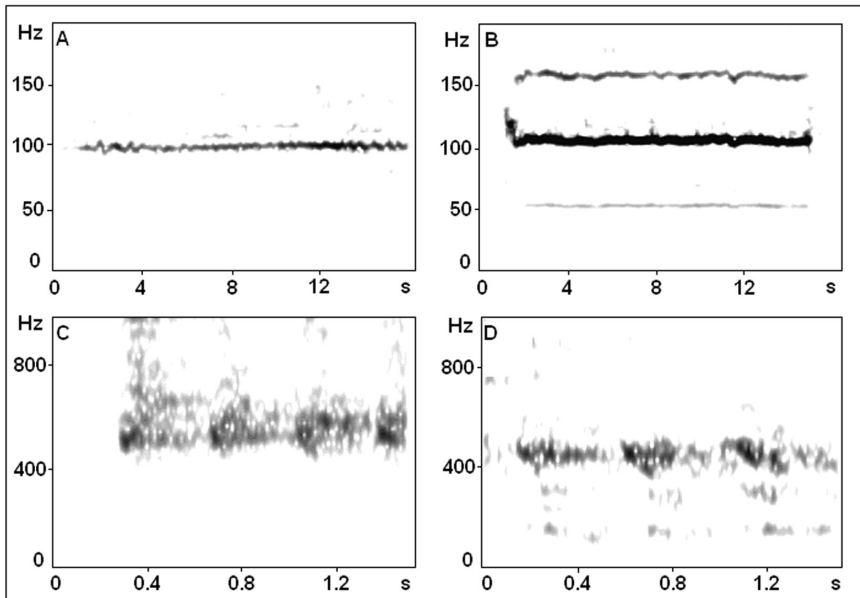


Figure 1: Spectrograms showing examples of models and sound imitations by two African elephants, Mlaika and Calimero. **A**, Sound of distant truck, **B**, Mlaika's truck-like call, **C**, Chirps emitted by an Asian female elephant, **D**, Chirp-like calls emitted by Calimero.

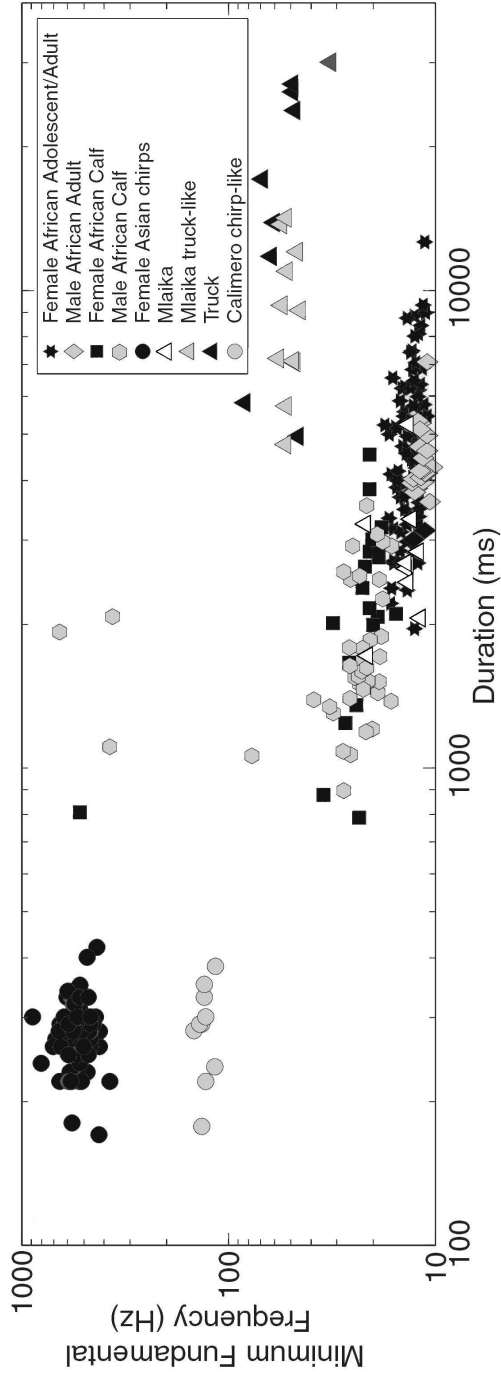


Figure 2: Imitation of sounds by Mlaika and Calimero. Truck-like calls (grey triangles) are similar to the truck sounds (black triangles) and differ from her normal calls (white triangles), which are similar to the sounds made by other African elephants (black star, grey rhombus, black square, grey hexagonal). Calimero’s chirp-like calls (grey circles) are similar to the chirps of the Asian females (black circles). Scatterplot of frequency versus duration for ten calls of each source.

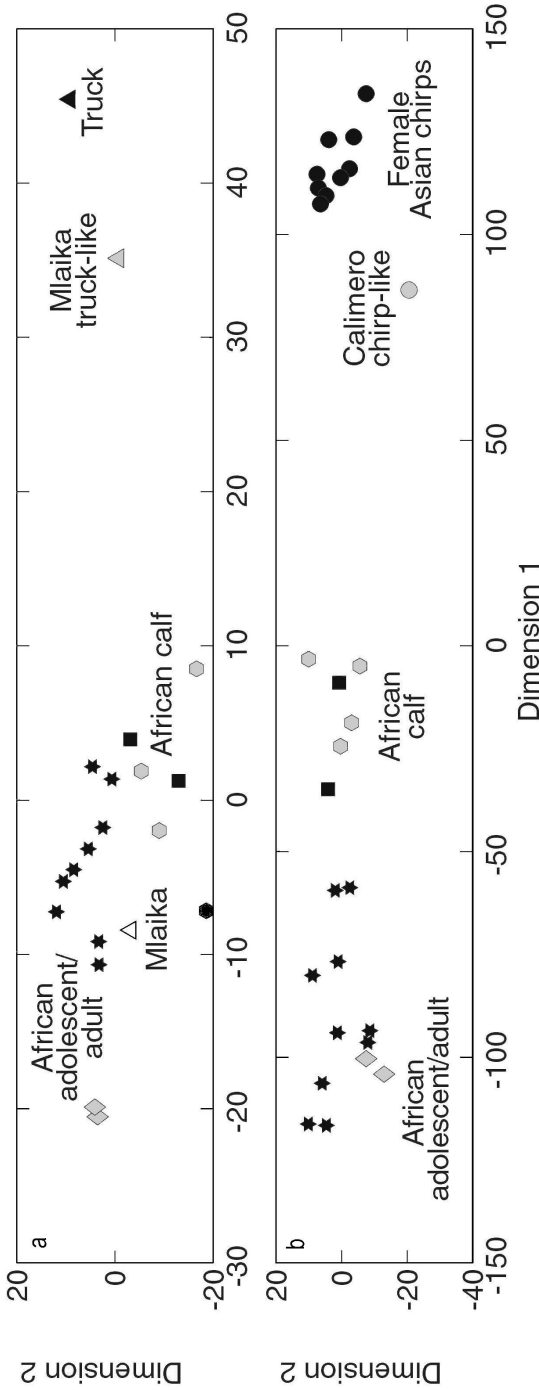


Figure 3: Imitation of sounds by Mlaika and Calimero. Truck-like calls (grey triangles) are similar to the truck sounds (black triangles) and differ from her normal calls (white triangles), which are similar to the sounds made by other African elephants (black star, grey rhombus, black square, grey hexagonal). Calimero's chirp-like calls (grey circles) are similar to the chirps of the Asian females (black circles).
a, Multidimensional scaling plot of means for each source in Fig. 2, apart from the chirp sounds, **b,** Multidimensional scaling plot of individual means from chirps of nine Asian female elephants and Calimero's chirp-like calls. Legend is in Fig. 2.