

## SUMMARY

Duiker antelope constitute a distinct tribe within one of the most diverse mammalian families, the Bovidae. Current taxonomy allows for the recognition of the monotypic *Sylvicapra* (a grassland specialist) and the highly diverse *Cephalophus* which includes 18 forest species. Although the monophyly of the group has never been questioned, the placement of taxa within the tribe has proved problematic. The aim of this investigation was therefore to reconstruct the group's evolutionary history using three investigatory parameters: nucleotide sequences from two mitochondrial DNA genes, comparative cytogenetics, and fluorescence *in situ* hybridization (FISH).

Nucleotide sequences were obtained from the complete cytochrome *b* gene and a 767 bp portion of 12S rRNA from all 19 recognized duiker species. Scatter plots showed no significant evidence of cytochrome *b* saturation even though several of the species are characterized by relatively high sequence divergences; pairwise comparisons based on 12S rRNA data showed a monotonic linear increase over time. A consistent finding of the molecular sequence study is the retrieval of four adaptive lineages. The most basal group comprises the conservative dwarf species (*C. monticola*, *C. maxwellii*), with the savanna specialist (*S. grimmia*) placed apart from all forest duiker. The giant duiker group includes *C. silvicultor*, *C. spadix*, *C. dorsalis*, and *C. jentinki*. Within the red duiker lineage, a further subdivision was evident; an east African red duiker clade (*C. leucogaster*, *C. rufilatus*, *C. nigrifrons*, *C. natalensis*, *C. harveyi*) and a west African clade (*C. callipygus*, *C. weynsi*, *C. ogilbyi*, *C. rubidus*, *C. niger*). From these data it is proposed that duiker speciation has been driven largely by habitat fragmentation which probably led to the disruption of gene flow between geographic isolates. This is reflected by the relative abundance of species with 11 of 18 forest species associated predominantly with the east African forest which has a history of climatically driven fragmentation.

The G-banded complement of *C. spadix* was shown to be identical to that of six other species previously reported, extending the observation that speciation in duiker antelope has occurred in the absence of euchromatic chromosomal rearrangement. FISH, involving seven duiker species representative of the four adaptive lineages (conservative dwarfs: *C. maxwellii*, *C. monticola*; red duiker: *C. natalensis*; grassland specialist: *S. grimmia*; giant

duiker: *C. dorsalis*, *C. silvicultor*, *C. spadix*) revealed centromeric hybridization to all the autosomes. However, variation was found in the hybridization patterns of the sex chromosomes which supported the delimitation of the four adaptive groups based on molecular sequence data and morphology.

The results from three independent data sets (sequence data, comparative cytogenetics, FISH) question, and in some instances support, several of the nomenclatural divisions in current duiker taxonomy. These include the recognition of *Philantomba* as genus name for *C. monticola* and *C. maxwellii*, an arrangement that would secure *Cephalophus* monophyly, and the relegation of *C. harveyi* to a subspecies of *C. natalensis*.

The 5' end fragment of *C. spadix* is identical to the sex species which is not in the literature book yet. This indicates the warning that species in duikers phylogeny be in the absence of molecular data. FISH, on the other hand, is a powerful tool for the identification of the four main evolutionary line (conservative lineage).

## OPSOMMING

Duikers verteenwoordig 'n unieke tribus binne een van die mees uiteenlopende soogdier families, die Bovidae. Huidige taksonomie laat toe vir die herkenning van die monotipiese *Sylvicapra* ('n savanna spesie) en die diverse *Cephalophus* wat 18 woudbewonende spesies insluit. Alhoewel die monofilie van die groep nog nooit bevraagteken is nie, is die plasing van taksa binne die tribus nog problematies. Die doel van hierdie ondersoek was dus die rekonstruksie van die groep se evolusionêre verwantskappe deur die gebruik van drie parameters: nukleotieddata van twee mitokondriale DNS gene, vergelykende sitogenetika, en fluoreserende *in situ* hibridisasie (FISH).

Nukleotieddata is verkry vir die volledige sitokroom *b* geen en 767 karakters van die 12S rRNS geen vir al 19 erkende duiker spesies. Verstrooingsgrafieke dui geen noemenswaardige bewys van versadiging aan vir die sitokroom *b* geen nie alhoewel verskeie van die spesies gekenmerk word deur relatiewe hoë nukleotied verskille, tweeledige vergelykings gebaseer op die 12S rRNS data dui op 'n deurlopende monotoniese lineêre toename oor tyd. 'n Deurlopende bevinding van die molekulêre nukleotied studie is vier evolusionêre lyne. Die mees primitiefste groep bestaan uit die konserwatiewe dwergspesies (*C. monticola*, *C. maxwellii*), met die savanna spesialis (*S. grimmia*) wat apart geplaas word van alle woud duikers. Die reuse duiker groep sluit *C. silvicultor*, *C. spadix*, *C. dorsalis*, en *C. jentinki* in. Binne die rooi duiker evolusionêre lyn is daar 'n verdere onderverdeling sigbaar: die Oos-Afrika rooi duiker groep (*C. leucogaster*, *C. rufilatus*, *C. nigrifrons*, *C. natalensis*, *C. harveyi*) en 'n Wes-Afrika rooi duiker groep (*C. callipygus*, *C. weynsi*, *C. ogilbyi*, *C. rubidus*, *C. niger*). Gegrand op hierdie data word voorgestel dat duiker spesiasie hoofsaaklik aangedryf word deur habitatsfragmentasie, wat lei tot die onderbreking van genevloeï tussen geografiese isolate. Hierdie bevinding word weerspieël deurdat 11 van die 18 woudbewonende spesies hoofsaaklik geassosieer word met reenwoude in Oos-Afrika. Die Oos-Afrikaanse reenwoude word veral gekenmerk deur klimaatfragmentasie.

Die G-band kompliment van *C. spadix* is identies aan die ses spesies wat tans in die literatuur beskryf is. Dit ondersteun die waarneming dat spesiasie in duikers plaasgevind het in die afwesigheid van eukromatiese herrangskikkings. FISH, op sewe duiker spesies verteenwoordigend van die vier hoof evolusionêre lyne (konserwatiewe dwerge: *C.*

*maxwellii*, *C. monticola*; rooi duiker: *C. natalensis*; savanna spesialis: *S. grimmia*; reuse duikers: *C. dorsalis*, *C. silvicultor*, *C. spadix*), dui op hibridisasie van die sentromere van al die outosome. Desnieteenstaande is variasie gevind in die hibridisasiepatrone van die sekskromosome ter staving van die afbakening van die vier evolusionêre lyne gebaseer op molekuleêre nukleotieddata en morfologie.

Ooreenstemming in die bevindinge van die drie onafhanklike datastelle (molekulêre nukleotieddata, vergelykende sitogenetika, FISH) bevraagteken, en in sommige gevalle ondersteun, verskeie van die nomenklature afdelings tans in gebruik is in duiker taksonomie. Hierdie sluit in die erkenning van *Philantomba* as die genus naam vir *C. monticola* en *C. maxwellii*, 'n skikking wat *Cephalophus* monofilie verseker, en die relegasie van *C. harveyi* tot 'n subspesie van *C. natalensis*.