Dedication

Verily, my prayer, my sacrifice, my living and dying are for Allah, the Lord of the Worlds

To my beloved mother and to the memory of my late father

Son and daughters

To my Husband

And all members of my family for support and encouragements

Fatima

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Abstract

This study was initiated with the aims to study the morphology and genetic characterization of hare(*Lepus capensis*) collectedfrom three geographically separated regions, namely East of the Nile, West of the Nile and between the Blue Nile river and the White Nile river in 2012 and 2015. The study focused on morphometric, craniometric,morphological and dental shape and genetic characterization in order to classify the hares. In morphometric, a tape and digital balance with 0.05 mm accuracy was used, craniometric a digital Vernier with of 0.01 mm accuracy. For microsatellite loci, Markov chain method of GENEPOP program was adopted to test genotypic. The Fstat program was used to calculate mean locus-specific 'allelic richness' and a Kruskal-Wallis test as well as a Friedmann test were used to examine variations (AR) among the three regions the tests were lower significantly ($P<0.011$ and $P<0.016$) respectively. The GENETIX software was used to calculate pairwise Cavalli-Sforza Edwards chord (CSE) genetic distances between the three regionsand to analysesthe variation on individual composite genotypes between the regions while analyses of Molecular Variance (AMOVA) were used to test relative genetic variation in the samples from the three regions. STRUCTURE analysis and a Bayesian statistical method were used to identify number of population groupings (clusters) compatible with the observed genotypic distribution. When assuming different numbers of genetic clusters, a likelihood analysis to assign each individual hare to one of the three sample regions was used.

Morphometric (Tail length, height and the distance between eyes) were significantly different ($P < 0.05$) among the three geographic regions. As far as sex was concerned, females were heavier ($P < 0.05$) than males, indicating sexual dimorphism. Craniometric (sizes of skull bones) were

different ($P < 0.05$) among the three geographic regions. Tympanic bulla width (TBW) was larger ($P< 0.013$) in males compared with that of females, thereby supporting sexual dimorphism.

As for the genetic characterization ofCyt (b) and D-loop sequences and microsatellite revealed that there wereno genetic differentiation between the three regions. Allelic richness valueslocus-by-locus were different ($P < 0.01$) in the three regions, across the three regions and frequencies of private alleles were generally low.Hares from the region between the two rivers recorded (7. 56%)lower allelic richness (allelic diversity) than hares from the West (17.94%) and East (16.50 %) regions.

STRUCTURE analysis suggested that there were two or three most likely genetic clusters (groupings/populations) that were underlying the composite data set, those two to three clusters coincided more or less nicely with the three discriminated regions.

The genetic characterization, dental analysis and external phenotype as well as the skull shape indicated that all the hares from the three geographic regions belong to *Lepus capensis* that is sexually dimorphic. Variations in morphometric and craniometric are attributed to variations in environmental factors within the three geographic regions; the overall genetic differentiation was low among the regions.

ملخص الدراسة

استندت هذه الدراسة على الأرانب البرية التي تم جمعها من ثلاث مناطق جغرافية هي شرق النيل وغرب النيل وبين نهرى النيل الأزرق و النيل الأبيض في الفترة من 2012 الى 2015. ركزت الدراسة علىالصفات الخارجية ، قياس الجماجم ,اشكال الأسنان والصفات الوراثية وذلكلتصنيف الأرانب.البرية . ولدراسة الصفات المورفولوجية تم استخدام شريط وميزان رقمي بدقة 0.05 جمو فيرنير(Vernier) بدقة (0.01)مم .ولدراسة مواقع المعلمات الوراثية استخدمت طريقة) (Markov Chan Methodمن سلسلة من برنامج GENEPOP Softلاختبارالنمط الوراثي .و تم استخدام برنامج Fstat لحسابتبايناتمتوسطات تكرارات الحزم الوراثية بواسطةالاختبارين(Kruskal-Wallis testو Friedmann test) وبفروقات معنوية منخفضة (P<0.011 وP<0.016) على التوالى. لمعرفة الاليل المميز لدراسة الاختلافات بين المناطق الثلاث.استخدمت كل من الزوج CSE (AMOVA)لاختبار التباين الوراثي النسبي لقياس مسافات الاختلافات بين المناطق الجغرافية المختلفة .استخدام طريقة التحليل الوصفى وطريقة و الطريقة إحصائية الافتراضية(Bayesian statistical method) لتحديد التجمعات السكانية (مجموعات) التى تتوافق مع التوزيع الوراثي النمطىتم افتراض مجموعات مختلفة وراثيةلتحليل التشابه لتحديد توزيع كل فرد إلى واحدة من مناطق عينات الدراسة الثلاث.وجدت فروقات معنوية(P <0.05)فى قياس طول الذيل ,الطول الكلى للحيوان والمسافة بين العينين) بين المناطق الجغرافية الثلاث. بالنسبةللجنس كان وزن الإناث > P) (0.05 اعلى من وزنالذكور مما يشيرالى ظاهرة الاختلافات الشكلية باختلاف الجنس .

هنالك اختلافات معنوية(P < 0.05)فى جماجم الارانب البرية فى المناطق الجغرافية الثلاثة.عرض طبلة الاذن(TBW) كان اكبرفى الذكورمقارنة بالاناث (P <0.013>) مما يدعم ظاهرة إزدواج الشكل الخارجى باختلاف الجنس.

بدراسة المعلمات الوراثية (microsatellite)*D*-loop , و سيتوكرومبى(*b*) Cyt)لقيم التباينات الوراثية اوضحت الدراسة انه لا توجد اختلافات وراثية بين المناطق الجغرافية الثلاث. بينما وجدتاختلافاًمعنوية منخفضاً (P<0.01)بين موضع ألاليلات المميزة فى تكرار الحزم الوراثية في المناطق الجغرافيةالثلاث.من الواضح أن الأرانب البرية من منطقة بين النهرين سجلت(7. 56%) اقل تنوع فى الاليلات من الأرانب البرية فى المنطقتين الغربية(17.94%)والشرقية(16.50%).اوضح التحليل اوصفى أن هناك اثنين الى ثلاث مجموعاتوراثية هىالأكثر احتمالا(جمعاتسكانية) من خلال تحليل البيانات التى تم

جمعها.اوضحت الصفات الوراثية، اشكال الأسنان و االمظهر الخارجي وكذلك شكل عظام الجماجم أن جميع العينات من المناطق الجغرافية الثلاث تنتمي إلى نوع واحد هو *(Lepus capensis)* مع وجود اختلافات فى الشكل الخارجبوتعزى الاختلافات في الصفات المورفولوجية وقياس عظام الجمجام للاختلافات البيئية في المناطق الجغرافية الثلاث الا ان الاختلاف الجينيالكلى كان منخفضاً بينمناطق الدراسةالثلاث .