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Table of Contents

Status and Conservation of the Striped Hyena (*Hyaena hyaena*) in the Occupied Palestinian Territories (West Bank)

Elias N. Handal*, George H. Qumsieh, Shayma Y. Hammash and Mazin B. Qumsiyeh

Abestract: The striped hyena (*Hyaena hyaena*) in Palestine is one of the four living hyena species in the whole world. There have been no studies on the status of the striped hyena in the West Bank over the past twenty-five years. Therefore, this paper presents a detailed study based on data collection and field observations (including camera traps) that add to the existing knowledge about this unique carnivorous mammal. The researchers collaborated with the Environmental Quality Authority in the new animal rehabilitation unit which provided the researchers with both deceased and confiscated animals. The observations in this study significantly extend the distribution range of the hyena from the eleven localities reported earlier to over twenty localities. The study also discusses the educational efforts that were made to raise awareness and address the myths that allow people to kill hyenas, including the enforcement of the 1999 environmental law, and the prospects for the future of hyena populations. The researchers are cautiously optimistic concerning the future of this species especially in light of the education and awareness campaigns in addition to the more strict enforcement of laws by the EQA and the newly-established environmental police units. One challenge remains open which is the Israeli occupation that limits the accessibility of Palestinian officials to 60% of the West Bank which harbors some 90% of the hyena habitats in the Palestinian territories.

Keywords: *Hyaena hyaena*, Striped Hyena, Palestine, West Bank, Conservation.

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Introduction

Palestine's location between Europe, Asia, and Africa gives it a unique geography and geology that enhance the local biodiversity relative to other countries at the same latitude (Qumsiyeh, 1996). This country has five ecozones (the central highlands, the semi-coastal region, the eastern slope, the Jordan valley and the coastal region) and four biogeographical regions (Mediterranean, Irano-Turanian, Saharo-Arabia and Sudanian Penetration) (Amr *et al.*, 2018; Qumsiyeh *et al.*, 2016; Whyte, 1950; Zohary, 1945). Palestine used to have over 130 recorded species of land mammals a few millennia ago, but nearly twenty species became extinct, mostly the large ones (Meiri *et al.*, 2019). The Family Hyaenidae includes medium to large-size carnivores with only four extant species (*Crocuta crocuta, Hyaena hyaena, Hyaena brunnea,* and *Proteles cristata)* localized in Africa, southwest Asia and India (AbiSaid and Dloniak, 2015; Green, 2015; Wiesel, 2015; Bohm and Höner, 2015). Three subspecies of the striped hyena have been recognized, of which *Hyaena hyaena syriaca* is considered near-threatened globally and endangered locally (Qumsiyeh, 1996; Mendelssohn and Yom-Tov, 1999; Dolev and Perevolotsky, 2004; Meiri *et al.*, 2019). Because of their wide geographical distribution, the supposed distinguishing characters of the three subspecies intergrade significantly (Qarqaz *et al.,* 2004). *Hyaena hyaena* is distributed throughout Africa (except for the Southern parts), the Middle East including Turkey, Iran, Arab countries such as the Arabian Peninsula, the Levant, Iraq, and the Caucasus (Azerbaijan, Armenia, Georgia), and extends into the central Asia and into India (Kasparek *et al.*, 2004). The local status and conservation issues surrounding the striped hyena need

to be further studied and updated. The last overview conducted in the West Bank was about twenty-five years ago (Qumsiyeh, 1996). Herein, this study reviews the past and present distribution of the striped hyena in the Palestinian Territories and discuss some ecological and conservation issues focusing on the threats and the future for the striped hyena.

Materials and Methods

The Palestine Museum of Natural History (PMNH) and Palestine Institute for Biodiversity and Sustainability (PIBS) were founded in 2014 at Bethlehem University, Bethlehem, Palestine with the aim of the conservation of habitats, fauna, and flora (Qumsiyeh *et al.*, 2017). The field teams of the PMNH/PIBS have engaged in data collection in the West Bank to improve the existing databases. Since 2018, additional data were collected using camera traps (Simmons Whitetail Trail Camera; Night Vision Camera) that were placed near water resources in Al Makhrour for four times. Furthermore, the strengthening of law enforcement by the environmental police (newly established) by the Environmental Quality Authority (EQA) resulted in collecting new data in relation to both dead hyenas (e.g. road kills or confiscated from illegal hunters) and living animals for rehabilitation and release. The researchers also added occasional data from field observations documented with photos, date and location. All observations were catalogued in our database with GPS points for each observation including some data on the behavior and ecology of hyena. Maps were prepared using GIS, and the biogeographical map of Palestine of the Environmental Quality Authority (EQA) for the hyena distribution including some data of the past distribution of this species after Qumsiyeh (1996) and Mendelssohn and Yom-Tov (1999).

Results

Observation localities and dates (Figure 1): Al Makhrour (April, 2016; August, 2018), Osh Ghrab (May, 2019), Za'tara (June, 2019), Kusra (2016), Beit Sahour (January, 2009), Hebron (28.7.2015), Bait Laqya (23.8.2017), Dura Al Khalil (12.6.2013), Idna (6.1.2009), Cum village in Hebron (4.5.2013), Al Thahriya (9.4.2019), Sureef (24.3.2014), Deir Ghassana (7.9.2019), Wadi Rashayda (12.11.2013), Al Ojja (9.9.2014), Sa'eer (3.3.2018), Nahaleen (15.5.2018), Jab'a (2013), Al Ramadeen (12.2.2020, Figure 2), Tarqumya/Wadi Al-Quff (16.2.2020), Jinsafout (1.2.2020), Wadi Ta'amrra (5.4 to 25.4.2020). Figure (1) demonstrates the distributions from previous records of Qumsiyeh (1996) and Mendelssohn and Yom-Tov (1999) and shows the new distribution observation by PMNH which seems to be clustered in the Southern part of the West Bank.

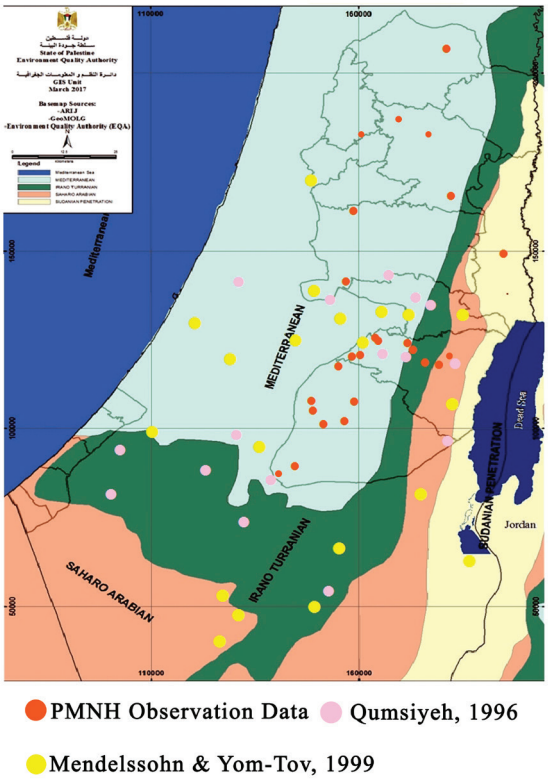

Figure 1. Striped hyena distribution in Palestine, using current and previous data from Qumsiyeh, 1996 and Mendelssohn and Yom-Tov, 1999.

This study, thus, doubled localities in the West Bank from eleven to twenty-one localities. The striped hyena has a wide distribution covering all biogeographical zones, and is highly adaptable to different habitats; something most likely attributed to its diet on carrion (Figure 1; Qumsiyeh 1996; Amr 2012). The striped Hyena is a medium-sized mammal with a robust jaw and large

sagittal crest that allows for a massive muscle attachment for crushing bones. The striped hyena has thirty-four teeth (dental formula M 3/3. Pm 1/1. C 4/3. I 1/1 see Qumsiyeh, 1996). Striped hyenas can reach >50 kg in weight as adults, and their total body length can be between 85 and 146 cm and tail length from 25 to 40 cm. A male and a female from areas of the West Bank were brought to the researchers by the EQA. The pregnant (older – estimated at 7-9 years old) female was from Al-Ramadeen having a total length of 146 cm, tail 31 cm, hind legs 22 cm, and the ears' length 16 cm. These are, by far, the largest measurements recorded for the striped hyena in this region. The male from Tarqumya was a young male (probably two years old) with a total length of 134 cm, tail 27 cm, hind legs 21 cm, and ears length 15 cm. The forelegs are longer and more powerful than the hind legs. The PMNH team made observations looking for the Striped Hyena during more than one-hundred field trips since 2014. Discussions were also made with locals, looking for hyenas and hyena tracks (dens, footprints) and occasionally using camera traps (Figure 2). All these observations support the notion that these animals are solitary and come together only for mating and when rearing their young ones. Only on two occasions, the researchers have observed hyenas together: On September 7, 2019, three were seen together (a mother and two near adult cubs) in Deir Ghassana, and in Wadi Ta'amra, A mother and one cub were located in April 2020. The latter case was interesting in that the locals reported seeing the pair several times from April 5 to April 25 in 2020. On one occasion, a shepherd reported seeing the hyena attacking a fox. A photograph was taken on a field visit to the site where two dead foxes were found after being eaten (Figure 4D). Camera traps were used in Al Makhrour Valley to detect Hyena near the water spring (Ain Imdan) (Figure 2).

On February 13, 2020, the EQA brought one female hyena that was killed by a poacher and dragged behind a car. Upon autopsy, this hyena was found pregnant with

Figure 2. The Striped Hyena from Al Makhrour Valley using a night camera trap.

a single male fetus (near full term) and the uterus showed no uterine scars of previous pregnancies (i.e. G1P0).

This case (Figure 3) provided a good educational model to discourage people over killing hyenas. The researchers reported the rehabilitation and the successful release of a young hyena. The EQA confiscated a hyena that was offered for sale on facebook. It was brought to the researchers on April 9, 2019. It was approximately a three-month-old hyena. A veterinarian injected the hyena with the rabies vaccine and checked its health. The researchers ensured that the female hyena was not to be released immediately (would have to be dependent on a mother for training). A special large secluded enclosure (about 10x15 m) was constructed in the ground in the PMNH botanical garden. The hyena immediately noticed the olive tree and start digging to make a shelter (Figure 4C). The hyena (dubbed Linda) was fed mostly animal remains and occasionally some vegetables and fruits, with minimal human contact.The decision was made to release the hyena during late winter/early spring because of its ability to defend itself (size and weight increased more 2 to 3 folds) and because of the availability of nutrients. The release location was a distant protected area far away from people to the west of Bethlehem District. The release date was February 26, 2020 (Figure 4A and B). The transportation cage was opened to the direction of the forest area and away from the populated areas. Immediately, Linda proceeded to walk casually in that direction

Figure 3. **A**: Hyena killed by a local from Al Ramadeen, **B**: A near-term male fetus from the dead female.

sniffing the ground and the air. On a visit week later, the researchers found tracks of the same hyena (judging by the foot print size) approximately 2 km to the west of the release site in the wooded areas near an outcropping of limestone dotted with caverns. The researchers left some food in the area one more time. This first-recorded successful release of a rehabilitated hyena to the wild in Palestine served as an educational tool for people and was covered through mainstream news media (e.g. associated press: http://www.aparchive.com/metadata/HZ-Mid-East-Hyena/bcb66d1bba1f43c181f6fbd5cbb92110).

PIBS and PMNH became major centers for biodiversity research, conservation,

Figure 4. A-B striped Hyena released in an area to the West of Bethlehem District, **C**: The hyena dug under an olive tree in the enclosure during rehabilitation, **D**: A fox eaten by a hyena.

and environmental education and awareness in the Palestinian territories. Their efforts include animal rehabilitation and release. Their teams work with school students to create a new generation of people that respect nature to prevent and decrease infringements on wildlife. The successful story of rehabilitating and releasing a striped hyena to the wild (first of its kind in Palestine Figure 4) coupled with the pictures of the baby hyena (Figure 3) produced educational lessons. In fact, this was translated to an educational module to increase the awareness about the importance of protecting the hyena (Figure 5).

Discussion

The striped hyena is globally considered near-threatened (NT) due to the decrease in its population according to the IUCN criteria (Meiri *et al.*, 2019; AbiSaid and Dloniak, 2015; Dolev and Perevolotsky, 2004). In Palestine, the striped hyena is considered as an endangered (EN) species due to the local threats that affect its existence and population numbers (Meiri *et al.*, 2019 ; Mendelssohn and Yom-Tov, 1999; Qumsiyeh, 1996). Human myths around hyenas go back to ancient times (Frembgen, 1998). The striped hyena is

Figure 5. Hyena educational module prepared and exhibited at the Palestine museum of Natural History.

the species found in Palestine and adjacent areas such as Jordan. In the study area, there are many myths ranging from sorcery (Frembgen, 1998), to claiming humans hunt hyenas for the importance of certain hyena parts in curing illnesses (Qarqaz *et al*., 2004; Frembgen, 1998).

The researchers heard from numerous sources in the study area that the hyena urinates on its victims including humans causing them to be drugged and then dragged to the den. These and other myths led to the illegal hunting of hyenas. Together with urbanization and climate change (including desertification spreading from the Saharo-Arabian region), habitats for all mammals have been shrinking. While hyenas are more adaptable than other carnivores such as wolves and leopards, the study anticipates their populations to be affected also (Amr, 2012). The practices of the Israeli Occupation including building the separating wall and colonial settlements further lead to habitat destruction and restrictions on the movement of hyenas (Adawi *et al*., 2017).

Hyenas usually avoid human populations but the initial survey here and anecdotal evidence from locals indicate increasing human-hyena contacts. Striped hyenas are usually solitary animals and the three seen in Dair Ghassana together in September 2009 are probably a mother with two cubs. The same was noted with red foxes in Palestine. This is likely due to the destruction of habitats leaving fewer available food sources hence bringing the species closer in the sprawling urban areas. In 1999, the Palestine Environmental Law came into effect. In the past twenty years or more, much has changed in terms of environmental education and awareness. More recently, the Environmental Quality Authority (EQA) with the support of the "Environmental Police" started to enforce such laws. Hence, an increase in the number of rescued animals or deceased animals was noticed. Most importantly, there is an emerging tremendous interest in the conservation efforts by the new generation. The Facebook story about the killed pregnant hyena (Figure 3) had

over 55,000 views, and generated over one-hundred comments mostly from young people. The first successful release of a hyena in Palestine brought more publicity. Even the killed hyenas after taxidermy and exhibit at the museum with an educational module (Figure 5) provide new insight to visitors. A significant positive feedback was received on this issue from people even those who cannot visit the museum now (due to COVID-19 pandemic) but see posts on facebook or via emails. In light of this, the researchers are cautiously optimistic on the future of this species especially in light of education and awareness campaigns and the more strict enforcement of laws by the EQA and the newly established environmental police units in the Palestinian Authority Areas

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A Post-Hatch Study of Larynx and Syrinx in Kuttanad Ducks *(Anas platyrhynchos domesticus)*

Firdous A. Dar[1,*], Maya S. Krishnan[2] and Ashok N. Pillai[3]

Abestract: A developmental study of the larynx and syrinx in Kuttanad ducks was carried out using seventy-eight female birds ranging from one day to twenty-four weeks of age. The material was collected from six birds in each group at fortnightly intervals. Caudal to the base of the tongue protruding on the floor of the pharynx was a conspicuous elevation, known as the laryngeal mound. In this study, it is a raised, elongated lozenge-shaped structure occupying the caudal third of the floor of the pharyngeal cavity. The larynx is formed by cricoid, procricoid and paired arytenoid cartilages which become ossified with progression of age. The procricoid was found to be the smallest median cartilage of the laryngeal skeleton placed dorsally. An increase in the laryngeal length and width was observed as the age advanced; both attained their maximum value by the eighteenth week of age. The laryngeal mound is covered by stratified squamous epithelium with numerous pointed caudally directed papillae. These papillae are covered by the keratinized epithelium. The syrinx is a laterally dilated organ, situated ventral to the esophagus above the base of heart at the thoracic inlet, suspended within the clavicular air sac. In Kuttanad ducks, the syrinx is of a tracheobronchial type; *viz.* formed by the transformed six caudal rings of trachea and four to five rings of extrapulmonary primary bronchi. The skeleton of the syrinx consists of three components, namely the cranial cartilages (tympanum), rings of the dilated part, and the pessulus. The length of the syrinx increased linearly from the first day to the twenty-fourth week of age recording a maximum growth by week twenty-four. The width of the syrinx also increased with age. A slight decrease was observed in twenty-week-old birds followed by an increase in the succeeding groups.

Keywords: Larynx, syrinx, Kuttanad duck, post-hatch.

Introduction

The respiratory system is a good model for studying optimization from a functional perspective because it consists of linked structures with defined design parameters and an overall function that has a measurable upper limit, the maximum rate of oxygen consumption. Although, relentlessly being well studied for over four centuries in biology, few organs have withstood as much scientific interrogation such as the respiratory apparatus of birds, the lung-air sac system which has remained profoundly intractable.

The investigations of the respiratory tract concentrate on several aspects, including bioacoustics, neuroanatomy, the respiratory system physiology, morphological-ecological analyses of the relation of the respiratory tract structure to the life habits yet without any concentration on developmental descriptions (Weibel, 1998). Among the morphoanatomical investigations of birds, a certain attention is devoted to the studies of the respiratory tract. The factors determining the designs of the vertebrate respiratory systems include the physiochemical characteristics of the respiratory medium used, the nature of habitat occupied, and the lifestyle pursued. This in turn reflects the structural variations in animals and birds residing in a particular area. The extensive anatomical plan of the lung

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air-sac system of birds has speculatively been alleged to predispose it to fast diffusion of air-borne diseases while intensifying the spread of harmful effects of toxic air pollutants. The poultry industry in India is mainly oriented towards chicken production. Ducks are the second important species among poultry. The indigenous varieties contribute more than 90 per cent of the total duck population in the country, and are being reared extensively under free range and backyard conditions. Kuttanad duck is the most popular waterfowl of Kerala. The literature gives only sporadic information on the sequential developmental pattern of different structural components including the larynx and syrinx of the respiratory system in water birds. Hence this research paper describes the normal post-hatch development of the larynx and syrinx in Kuttanad duck.

Materials and Methods

A developmental study of the larynx and syrinx in Kuttanad ducks is conducted using seventy-eight female birds ranging in age from one-day-old ducks to ones with sexual maturity i.e at the twenty-fourth week of age. The material was collected from six birds in each group at fortnightly intervals from a single hatch reared at the University Poultry and Duck Farm, Mannuthy under a semi-intensive system of management. After collecting, the material was fixed in 10 per cent neutral buffered formalin. The material was processed using routine procedures, and paraffin sections of a 5 µm thickness were taken for histological and histochemical studies. The sections were stained using the Haematoxylin and Eosin (H&E) staining technique for the routine histological studies (Luna, 1968), the Gomori's rapid one-step trichrome method for connective tissue fibres (Luna, 1968), Periodic acid Schiff's (PAS), and the Alcian blue method for mucopolysaccharides and the Best's carmine method for glycogen (Bancroft and Stevens, 1996).

Toluidine Blue-alizarin Red S Staining

The specimens were subjected to toluidine blue-alizarin red S staining after formalin, acetic acid and alcohol (FAA) fixation having the ratio of three components as 1:1:8 for approximately forty minutes. Further specimens were stained in 0.06 per cent toluidine blue in 70 per cent ethyl alcohol for forty-eight hours at room temperature. Twenty volumes of the stain solution to the estimated volume of the specimen were used. Soft tissues were destained in 35 per cent ethyl alcohol for twenty hours; 5 per cent for twenty-eight hours and 70 per cent for eight hours respectively. The specimens were counterstained in a freshly prepared 1 per cent aqueous solution of Potassium hydroxide to which was added 2-3 drops of 0.1 per cent alizarin red S per 100 ml of solution. The specimens were transferred into the fresh 1 per cent KOH-alizarin mixture daily for three days, or until the bones had reached the desired intensity of red and soft tissues. The specimens were rinsed in water, placed in a 1:1 mixture of glycerol and ethyl alcohol for 1-2 hours, and were then transferred into fresh glycerol-alcohol for final clearing and storage.

Results and Discussion

Larynx

Protruding caudal to the base of the tongue on the caudal third of the floor of the pharyngeal cavity is the elongated lozenge-shaped laryngeal mound. The inlet of the larynx is a narrow slit on the dorsal aspect of the laryngeal mound guarded by rows of caudally directed cone-shaped papillae on either side of its rim and with scattered papillae on its surface (Figure 1). Similar observations are reported in turkey, fowl and goose (Getty, 1975), in Crow (Bock, 1978) and in long legged buzzard (Kabak *et al.,* 2007). The papillae are absent in ostrich (Pasand *et al.,* 2010) whereas in Stork, Onuk *et al.* (2011) reported the absence of papilla only along the laryngeal sulcus. The laryngeal mound is covered by stratified squamous epithelium with numerous pointed caudally directed papillae. These papillae are also covered by the keratinized squamous epithelium (Figure 2). At the inlet, the stratified squamous epithelium changes into pseudostratified ciliated columnar epithelium with numerous

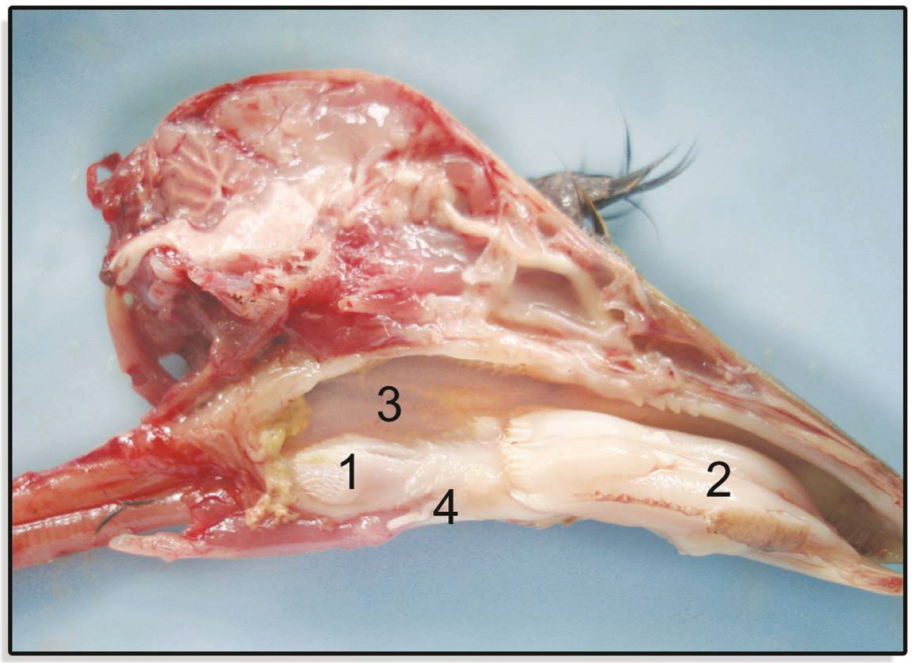

Figure 1. Laryngeal mound on floor of pharynx 1.Larynx 2. Tongue 3. Roof of larynx 4. Floor of larynx

simple tubular or alveolar mucous glands (Figure 3).

Lymphocytic infiltration was observed at the transitional zone. Lamina propria is thin and is composed of collagen and elastic fibres, blood vessels, and nerves also at the ventral median ridge of the cricoid cartilage. The submucosa contains the laryngeal salivary glands, collagen and elastic fibres, blood vessels and nerves (Figure 4). The connective tissue of the submucosa forms a thin capsule around the glands and the trabaculae extends through the parenchyma from the capsule. At the anterior part of the larynx they were smaller in size and lateral to arytenoid cartilages. At the middle part of the laryngeal mound, the glands are larger, and are situated more towards the lateral side of the arytenoid cartilages. At the level of the laryngeal fissure, few glands were also observed just beneath the epithelium. The epithelium and mucous glands showed a positive reaction for glycogen and PAS (Figure 5).

The main function of the larynx is the prevention of the entry of foreign bodies into the respiratory tract. The presence of the large numbers of papillae provide aid for this function. The shape of the larynx, which is a raised elongated lozenge-shaped structure,

Figure 2. Cross section of larynx showing keratinised stratified epithelium of papillae (14 weeks). Ayoub Shaklar staining x 400.

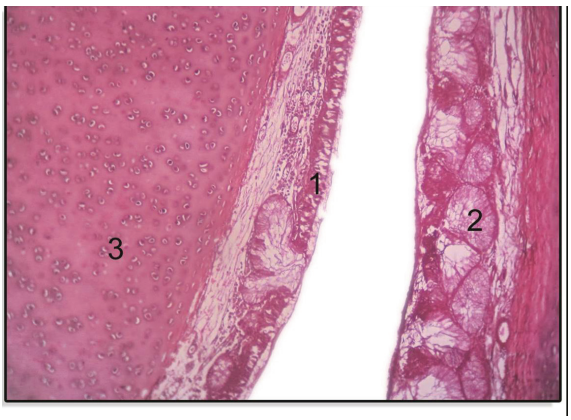

Figure 3. Cross section of larynx showing lining epithelium (12 weeks) H & E x 400 1.Pseudo stratified ciliated columnar epithelium 2. Mucous gland 3. Cartilage .

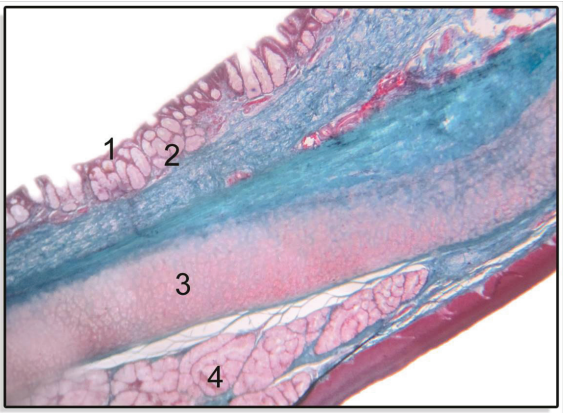

Figure 4. Cross section of larynx showing submucosal salivary glands (14 weeks) Gomori's one step trichrome method with fast green x 400 1. Lining epithelium 2. Mucous gland 3. Cartilage 4. Salivary gland.

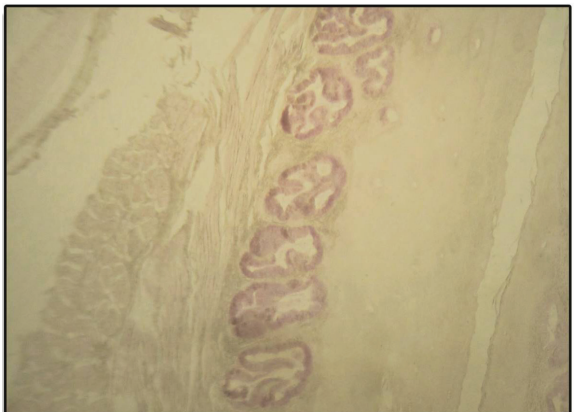

Figure 5. Cross section of larynx showing mucous glands positive for PAS. (12 weeks) x 400.

helps facilitate swallowing. During the ingestion of solid particles by ducks during foraging, the laryngeal mound moves a little caudally against the roof of the pharynx. During this movement, the caudally pointing papillae will help the mound to drag the particles into the esophageal pharynx. Besides, the larynx and upper trachea also help in the modulation of voice.

An increase in the laryngeal length and width was observed as the age advanced and both attained their maximum values by the eighteenth week as 1.923±0.005 cm and 1.351±0.005cm respectively. The difference observed may be attributed to the variation in the age, sex, and the natural habitat occupied. Two groups of salivary glands, *viz.* caudal and lateral cricoarytenoid glands, were observed grossly under the caudal aspect of the laryngeal mound and on its lateral border, respectively. Being situated caudal to the base of the tongue, the larynx has some resemblance to the tongue architecture. The presence of salivary glands on the larynx depicts this relation. Besides, although ducks enjoy little natural lubrication during feeding fully complemented by the salivary glands, the primary function of these glands appears to be mucogenesis.

The larynx is formed by cricoid, procricoid, and paired arytenoid cartilages (Figure 6), which become ossified as the age advances in accordance with the findings of Bradley and Grahame (1960) in relation to fowls, King and McLelland (1975) in relation to turkey, ducks, geese, Tabas *et al,* (1994) in denzil cocks, Pierko (2007) in mallards, Kabak *et al* (2007) in long legged buzzards, Tadjally *et al.* (2008) and Pasand *et al* (2010) in ostrichs and Onuk *et al* (2010) in storks. However, Bock (1978) reported that in crows, a complex of eight skeletal partially or completely ossified elements constitutes the larynx.

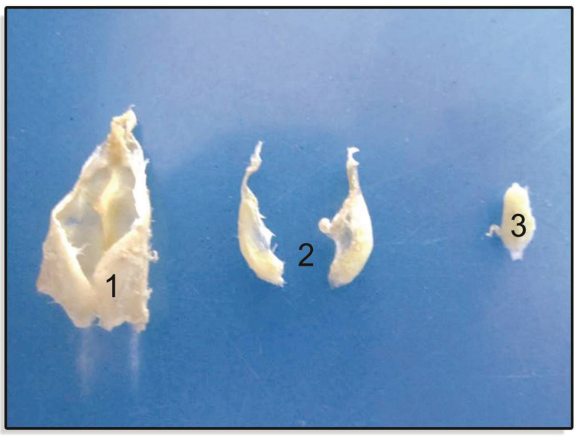

Figure 6. Cartilages of larynx (12 weeks) 1. Cricoid 2. Paired arytenoid 3. Procricoid

The unpaired cricoid cartilage in Kuttanad ducks is the largest among the laryngeal cartilages; it is triangular with broad caudal and pointed cranial ends, a body, and two wings (Figure 7). The medial border of both of the wings is articulated by a synovial joint with the procricoid. Similar findings have been reported by Zweers *et al.,* (1981) in pigeons.

The median aspect of the cricoid cartilage showed a triangular elevated prominence in the present study. Nazan and Gulsun (2010) also observed a similar

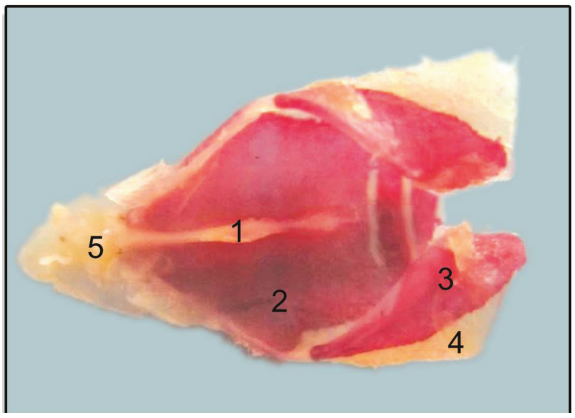

Figure 7. Dorsal surface of cricoid cartilage (14 weeks) 1. Median prominence 2. Body of cricoid cartilage 3. Wing of cricoid cartilage 4. Fibrous tissue 5. Rostral shovel part

a protuberance named crista ventralis in sea gulls. In Kuttanad ducks, the paired arytenoid cartilages shape the margins of the glottis and are sickle-shaped with a body and rostral and caudal processes. (Figure 8) Onuk *et al,* (2010) observed split glottis in geesse. The procricoid is the smallest median cartilage of the laryngeal skeleton placed dorsally (Figure 9). It is hammer-shaped with a rostral body and caudal tail. The bodies of arytenoid cartilages are joined with one another dorso-cranially by fibrous tissue, articulated with the procricoid caudo-medially by a synovial joint, and also glided closely on the dorsal border of the cricoid wing. On the other hand, the bilateral arytenoids in pigeons are only hinged to the body of the procricoid as a result of their particularly shaped articulation facets (Zweers *et al.,* 1981). The main function of the laryngeal cartilages is to provide the rigidity to the larynx. A protective function to any of the soft tissue cannot be ascertained because of the absence of soft structures such as the vocal cords in birds. The synovial joints formed by these cartilages with one another help change frequency, and, therefore, the pitch of the sound or the song produced. In Kuttanad ducks, there are five paired and one unpaired intrinsic ligaments. The paired ligaments are lateral cricoid, lateral crico-arytenoid, caudal crico-arytenoid, procrico-arytenoid, and procrico-cricoid. As observed in this study, the aryteno-arytenoid ligament was unpaired and the strongest among these ligaments. All these ligaments provid stability

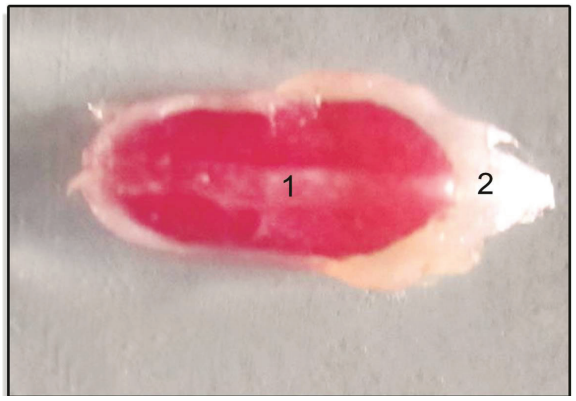

Figure 8. Procricoid cartilage with body and tail (14 weeks) 1. Body of procricoid 2. Tail of procricoid.

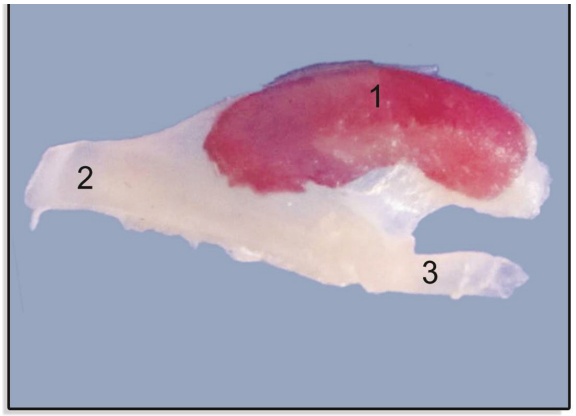

Figure 9. Lateral surface of Paired arytenoid cartilage (14 weeks) 1 Body of arytenoid 2. Rostral process 3. Caudal process

for the larynx which is particularly important during gasping with the marked rostral movements of whole mound. Two pairs of the intrinsic laryngeal muscles *viz.* dilator and constrictor were seen. These intrinsic muscles, in particular the constrictor, help in the continuous and rapid opening and closing of the glottis, which require high acceleration and a large force development. Moreover, if the glottis is to be opened and closed in a rapid succession over a period of time or if the glottis is to be held fully-opened or tightly closed against some resistance for a long period of time, such actions would require the presence of these muscles with a large cross-sectional area to avoid fatigue. These intrinsic muscles thus help the glottis to play role in respiration, swallowing, or sound production. Three pairs of extrinsic laryngeal muscles were also present; *viz.* tracheolateralis, cricohyoidius, and cleidotrachealis.

The complex arrangement of the extrinsic laryngeal muscles allows for a multitude of laryngeal movements depending on which muscle parts contract synchronously with others. If all the parts of the cricohyoideus contract simultaneously, the larynx will be protracted relative to the hyoid skeleton, and if the various slips of the tracheolateralis contract simultaneously, the larynx will be retracted relative to the hyoid skeleton. However, if the rostral slip of the tracheolateralis contracts at the same time as the dorsal part of the cricohyoideus, or if the caudal slip of the tracheolateralis contracts at the same time as the ventral part of the cricohyoideus, then the cricoid will pivot on top of the laryngeal chamber and, thereby, will change the configuration of this resonating chamber considerably (Homberger, 1999). The length and width of the larynx and glottis are presented in Table 1 and Figure 10. All the parameters were in significant positive correlation with age (r=0.782, 0.844, 0.642 and 0.840), body weight (r=0.704, 0.980, 0.823 and 0.967) and weight of the respiratory tract (r=0.772, 0.904, 0.706 and 0.895) respectively, as shown in Table 2. An increase in the laryngeal length and width was observed as the age advanced, and both attained their maximum value by the eighteenth week. A slight decrease was observed in length and width between the 18th and the 22nd week of age. As observed, the length and width of the glottis increased gradually as the age advanced.

Syrinx

The syrinx is found to be a laterally dilated organ, situated ventral to the esophagus above the base of the heart at the thoracic inlet (Figure 11), similar to the findings of Koch (1973) and Konig (2001) regarding song birds.

In Kuttanad ducks, the syrinx is of the tracheobronchial type, formed by thetransformed six caudal rings of trachea and four to five rings of extrapulmonary primary bronchi (Figure 12). The syrinx has been classified to be tracheobronchial in most common birds such as hens (Hummel, 2000; King, 1989; Nickel *et al*., 1977), ostriches (Yıldız *et al*., 2003), Bursa

Table1. Length and width of larynx and glottis in Kuttanad ducks at different ages (Mean±S.E)

	Length(cm)		Width(cm)	
Age	Larynx	Glottis	Larynx	Glottis
Day old	0.670 ±0.007	0.380 ±0.006	0.364 ±0.002	0.162 ±0.002
2 week	1.451 ±0.004	0.421 ±0.005	0.642 ±0.004	0.240 ±0.005
4 week	1.501 ±0.004	1.100 ±0.003	0.891 ±0.003	0.191 ±0.003
6 week	1.503 ±0.003	1.212 ±0.004	1.441 ±0.010	0.230 ±0.004
8 week	1.580 ±0.007	1.260 ±0.004	1.492 ±0.009	0.230 ±0.005
10 week	1.850 ±0.005	1.301 ±0.005	1.550 ±0.008	0.240 ±0.451
12 week	1.861 ±0.005	1.330 ±0.005	1.551 ±0.007	0.240 ±0.451
14 week	1.861 ±0.005	1.331 ±0.005	1.570 ±0.005	0.281 ±0.003
16 week	1.880 ±0.011	1.341±0.011	1.592 ±0.009	0.311 ±0.002
18 week	1.923 ±0.005	1.351 ±0.005	1.592 ±0.007	0.311 ±0.005
20 week	1.901±0.031	1.351 ±0.005	1.581 ±0.004	0.320 ±0.005
22 week	1.901±0.017	1.340 ±0.003	1.590±0.004	0.320 ±0.001
24 week	1.910 ±0.031	1.350 ±0.002	1.581 ±0.002	0.320 ±0.001

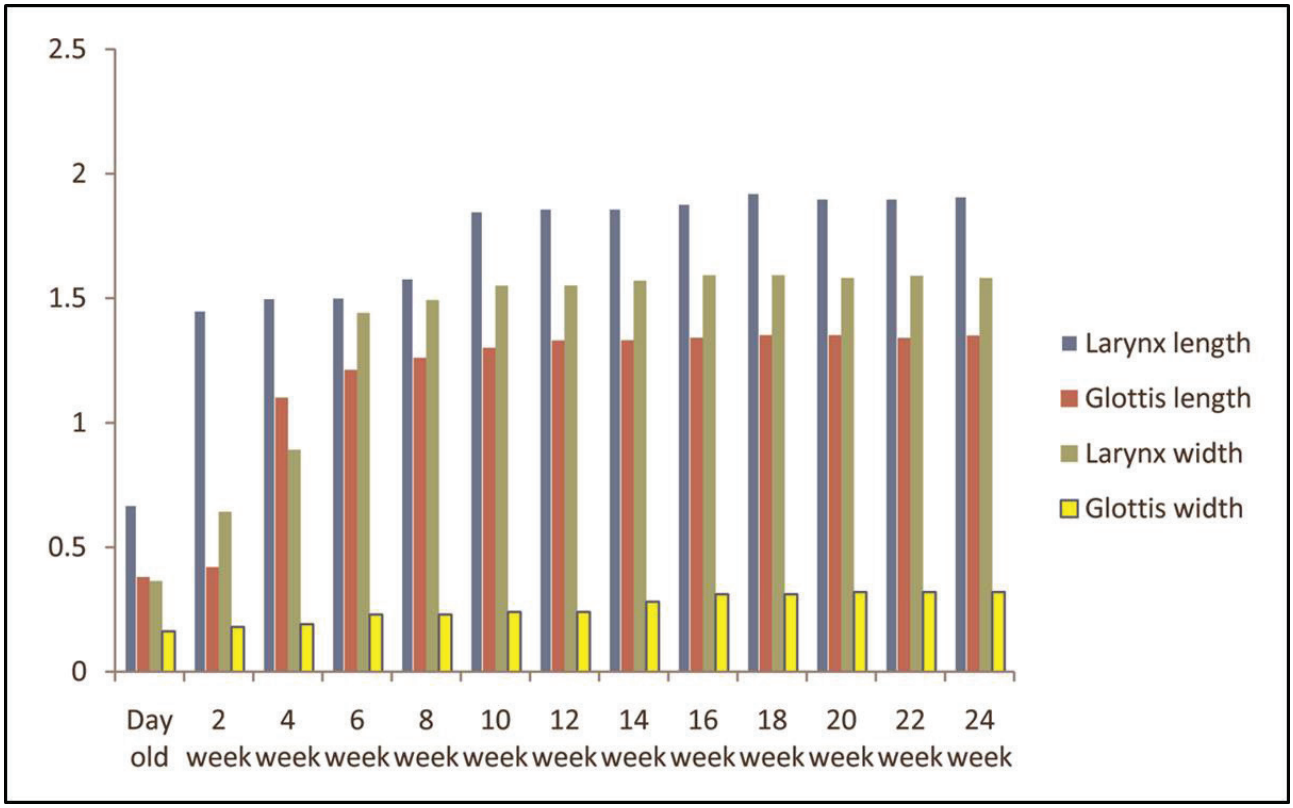

Figure 10. Age related changes in larynx in Kuttanad ducks

Table.2 Pearson's correlation coefficients (r) of larynx and syrinx with age, body weight and weight of respiratory system in Kuttanad ducks **Correlation is significant at the 0.01 level (2-tailed)

Width of glottis	0.840**	0.967**	0.940**
Width of Syrinx	0.757**	0.958**	0.902**

roller pigeons (Yıldız*et al*., 2005), the white turkey (Arican *et al*., 2007; Khaksar *et al.,* 2012), geesse (Onuk *et al*., 2010), long-legged buzzards (Kabak *et al.,* 2007), quails (Bayram and Liman, 2000; Çevik *et al*. 2007) and in sea gulls (Ince *et al*, 2012).

The skeleton of the syrinx in Kuttanad ducks consists of three components, namely the cranial cartilages (tympanum), rings of the dilated part, and the pessulus. Similarly, the Yildiz *et al.* (2003) reported the same findings in ostriches, Yildiz *et al.* (2005) in pigeons,Frank *et al.* (2007) in mallards and Khaksar *et al.* (2012) in female and male turkeys. The tympanum had six complete rings similar to Bursa roller pigeons (Yıldız *et al*., 2005), long-legged buzzards (Kabak *et al*., 2007), sea gulls (İnce *et al*, 2012), geesse (Onuk *et al*., 2010) and Japanese quails (Çevik *et al*., 2007). This finding was in contrary to five in pigeons (Yildiz *et al.* 2005)

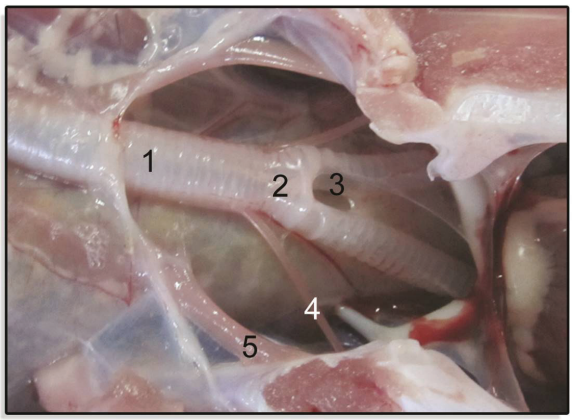

Figure 11. *Insitu* position of syrinx (10 weeks) Trachea 2. Syrinx 3. Tympanic membrane 4. Sternotrachealis muscle 5. Cleidotrachealis muscle.

and four in mallards (Yilmaz *et al.* 2012). The tympanum presented paired lateral and medial tympaniform membranes similar to the findings stated in regard to quails by Bayram and Liman (2000). The rings of the dilated part of the syrinx consisted of four

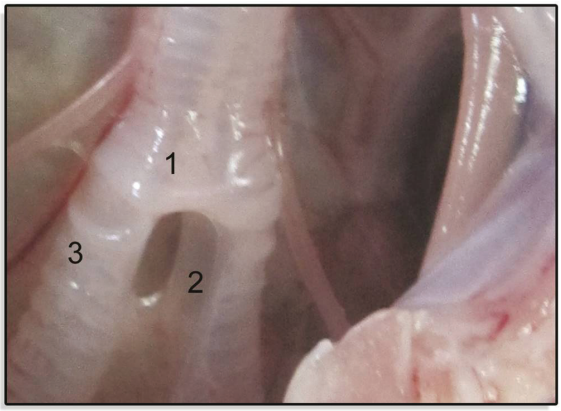

Figure 12. Composition of syrinx in Kuttanad ducks (10 weeks) Caudal rings of trachea 2. Tympanic membrane 3. Extra pulmonary primary bronchi.

bronchial half rings both on the right and left sides as against to eight (Warner, 1971, Lockner and Youngner, 1976) or ten (Frank *et al*., 2007) in singing birds. This variation in the number of the rings depends on the fusion of the cartilages. At early ages, these cartilages can easily be counted; however, with the advancement of age, these become fused and difficult to be counted.

The pessulus in Kuttanad ducks is a wedge-shaped cartilaginous structure up to 10 week of age and showed ossification with the progress of age (Figure 13). The pessulus in the mallard is composed of a bony tissue similar to that in singing birds (Frank *et al*., 2007; Taşbaş *et al*., 1994; Warner, 1972), yet different from that in ostriches (Yıldız *et al*., 2003) and chicken (King, 1989). The syrinx did not present any bulla formation in female Kuttanad ducks; Khaksar *et al.* (2012) observed the same in relation to turkeys.

The length and width of the syrinx are shown in Table 3; they are significantly and positively correlated with age (r= 0.958 and 0.757), body weight (r=0.956 and 0.958) and weight of the respiratory tract (r= 0.956 and 0.854) respectively. As observed from this study, the length of the syrinx increased linearly from day one to the twenty-fourth week of age recording a maximum length by week twenty-four. The width of the syrinx also increased with age and a slight decrease was observed in twenty-week-old birds followed by an increase in the succeeding groups.

The syrinx is lined with a pseudostratified, ciliated columnar epithelium with a few mucous glands (Figure 14). The basal cells have round to irregular nuclei, whereas the nuclei of ciliated cells were seen to be oval to elongate. The lamina propria was continuous with dense submucosa underneath forming the propria-submucosa, made of dense irregular connective tissue containing collagen and many elastic fibres with plenty of blood vessels and nerves. Lymphoid cells were also seen at the second week of age onwards. The next layer was the cartilaginous rings surrounded by perichondrium followed by the adventitial connective tissue.

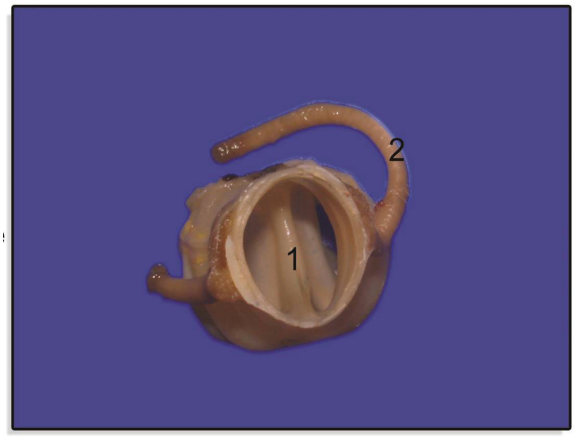

Figure 13. Syrinx showing pessulus (12 weeks) 1 Pessulus 2. Sterno-trachealis muscle

The dilated part of the syrinx is formed by the bronchial cartilages and is lined by the low columnar ciliated pseudo-stratified epithelium with plenty of the goblet cell groups. The paired lateral and medial tympaniform membranes of the tympanum present similar histological structures. Internally, the mucosa of the tympanic membranes consists of cuboidal or flattened cells with a few goblet cells scattered amongst them.

The density of the goblet and ciliated cells was lesser than those in the trachea. Underlying this layer, was the propria-submucosa, containing a connective tissue layer of coarse elastic fibres followed by a layer of loose, fine collagen and elastic fibres, various blood vessels, adipose cells, nerves, and scattered smooth muscle cells. The final layer consists of coarse collagen fibres interspersed with elastic fibres. The whole is bounded by the serosa formed by a single layer of squamous epithelium. Hodges

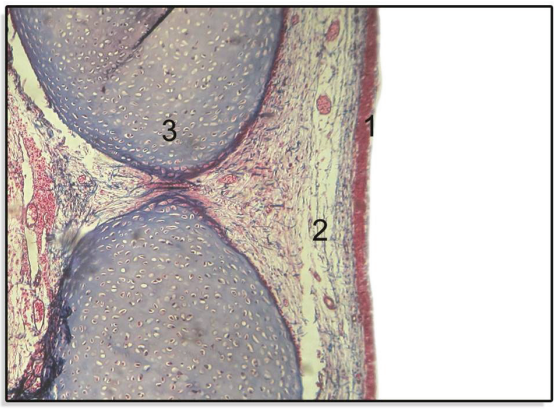

Figure 14. Cross section of syrinx showing lining epithelium (20 weeks) Gomori's one step trichrome method x 400 1 Lining epithelium 2. Lamina propria 3. Cartilage.

(1974) reported the same in domestic fowls, and Khaksar *et al.* (2012) in male and female turkeys; however, Bayram and Liman (2000) reported that lateral and medial tympaniform membranes were covered by stratified cuboidal epithelium in quails.

The principal change in the syrinx observed through the present study is the deposition of the cartilaginous matrix. From day one of age onwards, the perichondrium was composed of inner vascular and outer fibrous layers. With the progress of age, the number of chondrocytes per lacunae increased and by the sixth week, two to four cells occupied each lacunae forming an isogenous group of cells. At an older age in the post-hatch period, the proportion of intercellular matrix also increased. Each chondrocyte was surrounded by the pericellular matrix and each lacuna by a territorial matrix. The inter territorial matrix between lacunae, was stained lighter than the territorial matrix. From the tenth week onwards, the cartilages of the syrinx showed signs of ossification, but for a comparatively less degree than those in the trachea and larynx. The pessulus was highly ossified by week twenty-four of age.

The main function of the syrinx is voice production. However, in the present study, no bulla was observed in female Kuttanad ducks; hence voice production will be comparatively lower in males, which have the bulla. The syrinx may probably also help in minimizing the collapse or compression of the exchange tissue and pulmonary air ways during expiration by its valve-like action at the beginning. The syrinx is held in the clavicular air sac; therefore, when the pressure rises inside the clavicular air sac during expiration, a transient pressure gradient will be created from the sac to the interior of the syrinx which causes the bulging of lateral and medial tympanic membranes to bulge into the syrinx and obstruct it. Such a transient closure of the syrinx can reduce the pressure gradient across the lung during expiration and thus limits the compression. This valve-like action may be much pronounced in waterfowls including Kuttanad ducks because before going deep into the water, they expel maximum air from the air sacs to reduce resistance by the water.

Ossification of Larynx and Syrinx

In this study signs of ossification were absent in the larynx, trachea, and syrinx up to the sixth week of post-hatch life in Kuttanad ducks. Small, scattered foci of ossification started to appear at week eight of age in the laryngeal cartilages (Figure 15). The cricoid was the first to show signs of ossification followed by the arytenoid at its body and then the procricoid. Bradley and Grahame (1960) found that the cricoid and the arytenoid cartilages become ossified as age advances in fowls. Hogg (1982) reported mineralization in birds aged 105 days, specifically in the bodies of the arytenoid cartilages and only in domestic fowls .

The syrinx exhibited signs of ossification from the tenth week onwards. Compared to the trachea and larynx, the syrinx showed lesser degrees of ossification. Hogg (1982) reported mineralization in the syrinx of domestic fowls on the ninety-eighth day after hatching. In all cases, it was present only in the pessulus and the bases of the left and right first bronchial syringeal cartilages. However, Khaksar *et al* (2012) observed that the pessulus in female and male turkeys did not contain any ossified or cartilaginous tissues and was made up of a double folded mucous membrane. While holding the ducks by neck, this ventral ossification of the cartilages of

the trachea acts as a kind of adaptation meant to reduce the damage of the deeper tissues resulting from pressing and may also keep the trachea firm without any damage to itself.

Conclusion

Structural variations may occur in the respiratory system components among residing in a particular area. Variations may be due to the living habitat, nature of feeding, or extent of the flight. The variation both in the development and structure, documented in present paper, can be very helpful in providing future information on the sequential developmental pattern of different structural components including the larynx and syrinx of the respiratory system in water birds.

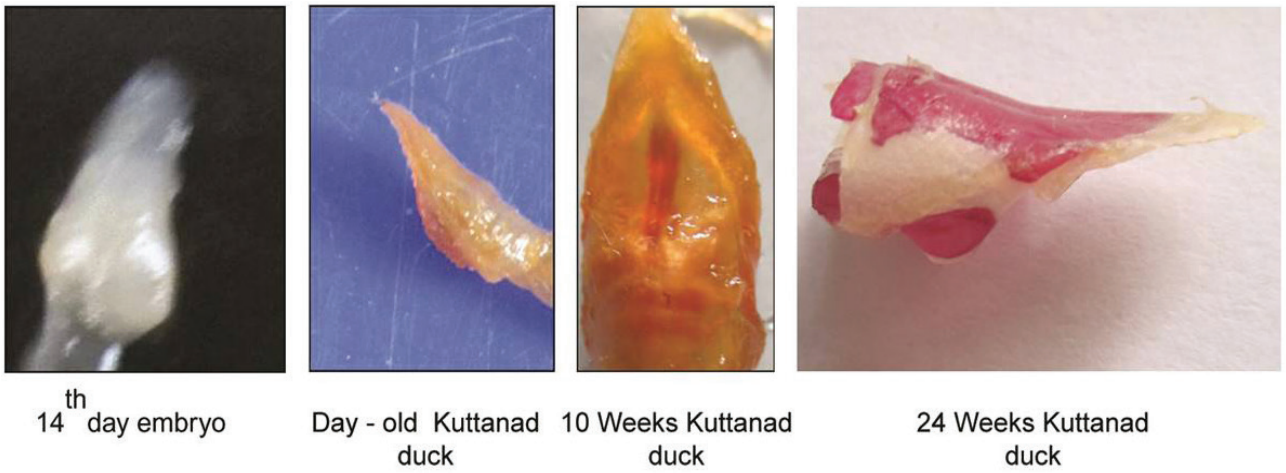

Figure 15. Alizarin staining of laryngeal cartilages at different ages

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Notes on the Pigeons and Doves (Family Columbidae) Occurring in the Gaza Strip – Palestine

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Abstract: Birds are the commonest terrestrial vertebrates among the fauna of the Gaza Strip. Hundreds of bird species have been recorded and more records are being added continually. Columbids (pigeon and doves), constitute a prominent component of birds, yet they have never been separately studied in the Gaza Strip. The current study aims at giving useful notes on the doves and pigeons occurring in the Gaza Strip. Field visits, observations, photography, and discussions with stakeholders were carried out to reach the goals of the study. Seven species of pigeons and doves were recorded in the Gaza Strip. The Rock Pigeon (*Columba livia*) was found to be the commonest while the African Collared Dove (*Streptopelia roseogrisea*) was the rarest. Different plumage colors of the Barbary Dove (*Streptopelia risoria*) are easily reared and traded in local zoos and pet shops. All pigeon and dove species are subject to poaching and hunting for different purposes including meat and pet trade. Finally, the study recommends raising ecological awareness among Gazans and the implemtation of protection measures in order to sustainably conserve bird fauna in the Gaza Strip.

Keywords: Bird fauna, pigeons, doves, Streptopelia, hunting, Gaza Strip.

Introduction

Bird fauna are among the best known creatures characterized by biodiversity around the globe (Pomeroy, 1992 and Bibby *et al*., 1998). In Palestine, which has a total area of about 27,000 km^2, 540 avifaunal species are known to inhabit all types of landscapes and ecosystems (Perlman and Meyrav, 2009). The strategic geographic location of Palestine along with its major migration routes contributes to the diversity of bird fauna (UNEP, 2003). The arid to semi-arid Gaza Strip, which covers an area of about 365 km^2 (1.5% of the total area of Palestine), has a diversity of bird fauna occurring in its diverse ecosystems and habitats. Hundreds of bird species have been recorded, and new more records are being added continually (Project for the Conservation of Wetland and Coastal Ecosystems in the Mediterranean Region – MedWetCoast, 2002; Abd Rabou, 2005; Yassin *et al.*, 2006; Abd Rabou *et al*., 2007 and Abd Rabou 2011a and b; 2019a and b). Urbanization constitutes a major threat to vertebrate fauna; particularly birds, in Palestine and hence the Gaza Strip (Qumsiyeh *et al*., 2014). Different groups of bird fauna are commonly hunted and trapped for different purposes in the Gaza Strip (Abd Rabou 2005 and 2020). In the fall season of each year, many Gazans erect fishing nets along the Mediterranean coast in order to catch the Middle Eastern migratory Common Quail (*Coturnix coturnix*), because of its delicious meat (UNEP, 2003; Abd Rabou *et al*., 2007 and Abd Rabou, 2011a and b; 2019a and b and Marwat *et al*., 2014).

Columbidae is a worldwide family of birds containing pigeons and doves. It is the only family in the order Columbiformes. It is one of the most threatened bird families in the world (Walker, 2007). Pigeons and doves primarily feed on seeds, fruits, and plants (Gutiérrez-Galán and Alonso, 2016). Their nests are commonly built on trees, ledges, or on the ground, depending on the species. Several species of pigeons and doves are commonly trapped or shot to be used

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as food or game items. All members of the Columbidae family are monogamous in the sense that one male mates with one female and forms a pair bond (Gibbs *et al.*, 2001). The Rock Pigeon (*Columba livia*) has been domesticated as a food species for hundreds of years (Shapiro and Domyan, 2013). In the Gaza Strip, many studies have been carried out to survey the bird fauna of various ecosystems. The arid to semi-arid nature of the Gaza Strip contributed much to the occurrence of many pigeon and dove species. Hence, the current study aims at giving valuable notes on the pigeons and doves inhabiting the Gaza Strip, while highlighting all threats facing them as well.

Materials and Methods

The arid to semi-arid Gaza Strip (365 km^2) is a coastal zone lying in the southern part of the Palestinian coast along the eastern shore of the Mediterranean Sea (Figure 1). It has five governorates: North Gaza, Gaza, Middle, Khan Younis, and Rafah. The local average annual rainfall is 300 mm. Sand dunes are the main feature of the western part of the Gaza Strip, while the clay and clayey lands predominate in the eastern part (Euroconsult and IWACO, 1994 and UNEP, 2003). Nowadays, the Gaza Strip has a population of about two million, with the population density reaching 5,500 inhabitants per square kilometer, making the Gaza Strip one of the most densely populated areas in the world (Abd Rabou, 2019b).

Procedures

The current study is descriptive in its style. Since 2002, frequent field visits and observations and discussions with local people have been carried out in order to determine the pigeon and dove species inhabiting the various ecosystems of the Gaza Strip. During the field visits, binoculars and digital cameras were mostly the common tools used for observation and documentation purposes. Animal markets, pet shops and zoological gardens (zoos) were commonly visited to study their bird content, with particular emphasis placed on columbids. Bird hunters, university students, and even local people were good contributors to the success of this work through their specimen provisions. All local literature concerning bird fauna in the Gaza Strip has been reviewed for the sake of this study. A variety of local, regional and international guide books have been used for the identification of bird species (Baha El Din and Atta, 1990; Disi and Hatoug-Boran, 1990; Harrison and Greensmith, 1993; Porter *et al.*, 1996; Shirihai, 1996; Abu Shammalah and Baha El-Din, 1999; and Cottridge and Porter, 2000).

Figure 1. A map showing the geographic location of the Gaza Strip.

Results

The findings of the current study pointed out seven species of pigeons and doves occurring in the various environments including captivity places within the limits of the Gaza Strip (Table 1 and Figure 2). Most of the pigeons and doves seem to be resident and breeding. In general, doves and pigeons are considered to be game birds, while also many species are being hunted and used for food in Palestine.

Table 1. Pigeons and doves of the Gaza Strip

Family	Common Name	Scientific Name
Order Columbiformes		
Columbidae	Rock Pigeon or Dove	*Columba livia*
	Namaqua Pigeon or Dove	*Oena capensis*
	Laughing or Palm Dove	*Streptopelia senegalensis*
	European Turtle Dove	*Streptopelia turtur*
	Eurasian Collared Dove	*Streptopelia decaocto*
	African Collared Dove	*Streptopelia roseogrisea*
	Ringneck or Barbary Dove	*Streptopelia risoria*

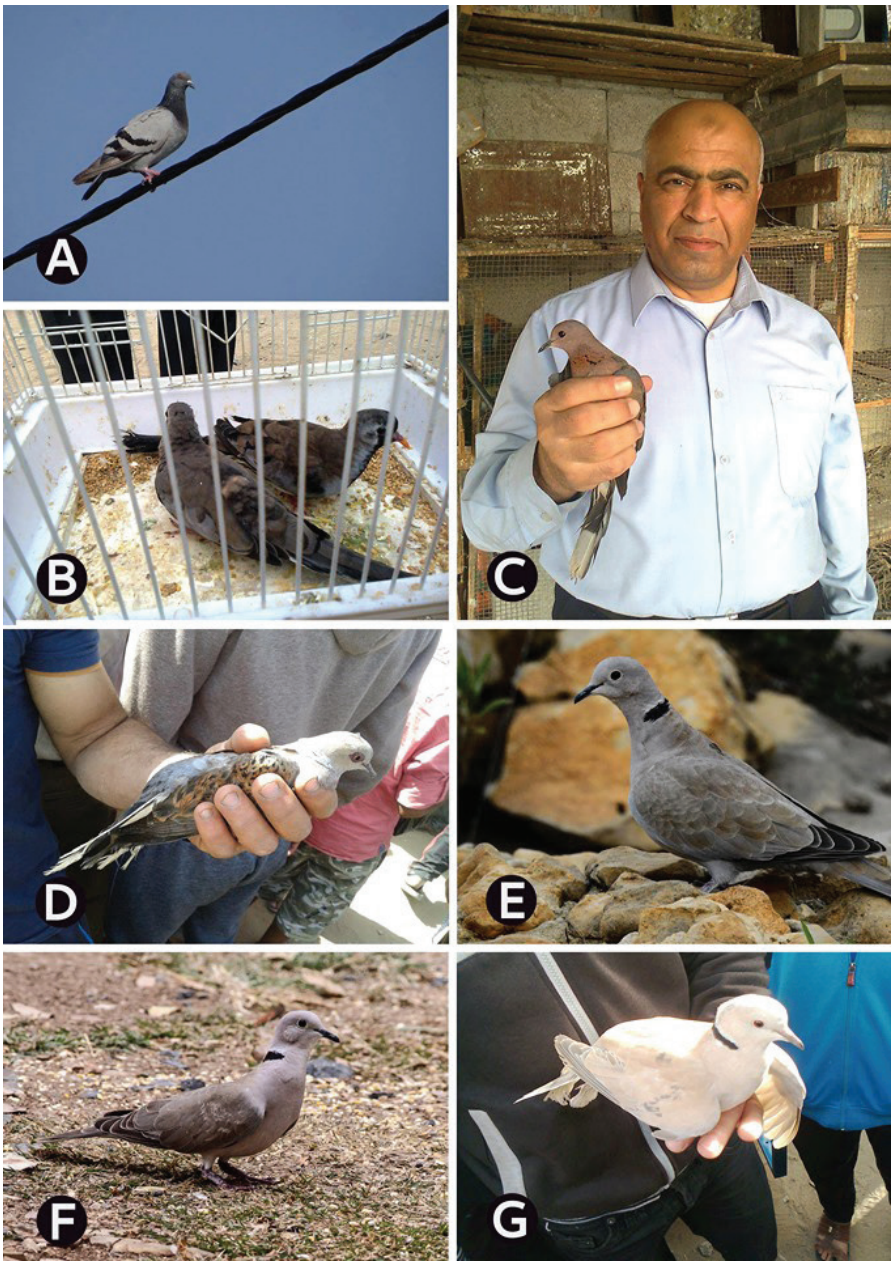

Figure 2. Pigeons and doves of the Gaza Strip: (A) Rock Pigeon (*Columba livia*), (B) Namaqua Pigeon (*Oena capensis*), (C) Laughing Dove (*Streptopelia senegalensis*), (D) European Turtle Dove (*Streptopelia turtur*), (E) Eurasian Collared Dove (*Streptopelia decaocto*), (F) African Collared Dove (*Streptopelia roseogrisea*), and (G) Barbary or Ringneck Dove (*Streptopelia risoria*)

Many pigeon and dove species were sometimes seen trapped using the same mist nets used to catch Quails (*Coturnix coturnix)* . The following paragraphs, display a description of each pigeon and dove species occurring in the wild and captivity places of the Gaza Strip.

Rock Pigeon or Dove (*Columba livia* Gmelin, 1789)

The Rock Dove is one of the most commonly seen birds throughout the year and everywhere in the Gaza Strip. The bird is often seen roosting or flying in flocks ranging from five to thirty members. The Rock Dove inhabits different places in the Gaza Strip ranging from terrains to urban, rural, and agricultural places. Generally speaking, the adults and young of Rock Doves, along with their eggs are at risk from feral and domestic cats and stray dogs. The various breeds of the Domestic Pigeon (*Columba livia domestica*), which are commonly reared by most Gazans and zoo and pet shop owners seem to be descended from the Rock Dove. In the scientific labs of the general biology and vertebrate zoology courses at the biology departments of local universities, live specimens of the Rock, Feral, and Domestic Doves are commonly brought to be used for dissection classes.

Namaqua Pigeon or Dove (*Oena capensis* Linnaeus, 1766)

The smallest of all dove and pigeon species occurring in the Gaza Strip is the Namaqua Dove (Long-tailed or Masked Dove). This species is characterized by having a very long black tapered tail, which reflects the bird's common name. The plumage has grey upperparts and a white belly. Males have a black face, throat, and breast. Despite its rarity, it is often encountered singly or in pairs in the southern and eastern parts of the Gaza Strip, which are not heavily urbanized. Locally, the bird is frequently kept as a pet in zoos and pet shops. Local bird hunters and traders claimed that the species can breed freely in captivity. The authors often observes cages containing the bird at pet shops and among the animals traded at Al-Yarmouk Market in the middle of the Gaza City.

Laughing Dove (*Streptopelia* or *Spilopelia senegalensis* Linnaeus, 1766)

The Laughing (Palm or Senegal or Little Brown) Dove is the commonest dove species that is often seen year round in the Gaza Strip. This resident breeder occurs everywhere locally including the wild, cultivations, rural areas, buildings and areas of human habitation. It is the meekest, most forgetful, and tamest bird in the Gaza Strip. Pairs or small parties of the species are often seen feeding on the ground or standing on electricity or telephone wires. The nests of the species, that usually contain two eggs, are commonly built on trees, shrubs, and even on top of buildings. Similar to other local dove and pigeon species, the eggs, fledgling, and adults of the Laughing Dove come under multiple threats including egg collection, nest destruction and the hunting of their adults for meat.

European Turtle Dove (*Streptopelia turtur* Linnaeus, 1758)

The European Turtle Dove is commonly seen throughout the year in the Gaza Strip. Similar to the Laughing Dove, this species is common in cultivated fields with open woods, clumps of trees, parks, and gardens. The species is commonly recognized by its browner color, and the black-and-white-striped patch appearing on the sides of the neck. The upperparts are distinctively mottled with chestnut and black. The bird seems to be in decline because of local poaching and shooting by Gazans for meat purposes.

Eurasian Collared Dove (*Streptopelia decaocto* Frivaldszky, 1838)

The Eurasian Collared Dove seems to be slightly larger than the afore-mentioned Turtle Dove. The overall color of this bird ranges from grey-buff to pinkish-grey. On the neck, the species has a black half-collar edged with white, from which it gets its name (Figure 2). Collared doves can become hand-tame in urban areas. As commonly observed in the Gaza Strip, the species often feeds on grains, seeds, and insects that are very close to human habitation and

agricultural fields. Similar to other doves, the species is also subject to hunting for meat purposes.

African Collared Dove (*Streptopelia roseogrisea* Sundevall, 1857)

Compared to the Eurasian Collared Dove, the African Collared Dove lives more in the wild and apart from human dwellings. Although both the Eurasian and African Collared Doves have a black collar on their hindneck, the Eurasian Collared Dove are generally darker in color overall (Figure 2). Locally, the two species are considered by birdwatchers and even pet animal traders as Collared Doves regardless of their specific characteristics. Regardless of its distribution and spread across Africa, the African Collared Dove is the rarest dove species recorded in the Gaza Strip. It is recorded in a very few numbers in the eastern and southern parts that are characterized by their aridity, low residential dwellings, and the spread of agricultural and grassy lands in addition to wastelands. In 2014, a pair of the species was seen caged for sale at Al-Yarmouk Market in the middle of the Gaza City.

Barbary or Ringneck Dove (*Streptopelia risoria* Linnaeus, 1758)

The Barbary Dove (sometimes known as Ringneck or Ringed Turtle or Ring Dove) is a domestic member of the dove family. Barbary Doves are easily kept and can live long in captivity, which explains why all local zoos, pet shops, and animal trade markets have cages of different sizes containing various light colors, with or without collars, of this domestic species. In fact, the frequent visits to zoos, pet shops, and animal trade markets demonstrated a mix of the afore-mentioned pigeon and dove species along with the Barbary Dove being caged together. Though it is doubtful for the species to occur or persist for long outside captivity in the Gaza Strip, a few numbers were encountered in the wild; particularly in the urbanized ecosystems. Many Gazans including birdwatchers ensured such occurrences of the species in many parks and agricultural fields as well.

Discussion

The diversity of wild animals; particularly bird fauna in Palestine; and hence the Gaza Strip, is highly attributed to the strategic location of Palestine at the meeting point of the three continents of Asia, Africa, and Europe, in addition to the climate, ecosystem and habitat diversities (Qumsiyeh, 1996 and UNEP, 2003). Palestine constitutes a stopover point for migratory bird fauna prior to continuing their annual migration from Eurasia to Africa and vice versa (UNEP, 2003). Columbids (order Columbiformes) form an important part of bird diversity in the Gaza Strip. The majority of the seven pigeon and dove species encountered throughout the current study (Table 1 and Figure 2) seem to occur everywhere in the Palestine environment; some of which have been encountered in the aviaries of pet shops, zoos and animal trade markets. The availability of nesting and breeding sites and feeding habits of pigeons and doves enhances their occurrence in large populations (Abd Rabou, 2005). The current species are said to be occurring in many ecosystems in Palestine and its neighboring countries to a varying extent (Evans *et al.,* 2005; Perlman and Meyrav, 2009; Khalilieh, 2016; Al-Oshoush and Al-Zoubi, 2017). No red lines concerning the hunting of birds are drawn and respected in the Gaza Strip (Abd Rabou, 2005; 2011a and b; 2019a and b). Even in the Mediterranean European countries, the illegal killing and taking of birds still occur in spite of the national legislations and international obligations (Brochet *et al*., 2016). The easy hunting of pigeons and doves for different purposes by Gazans may be attributed partially to the feeding habit of columbids primarily at man-made sites and infrequently at natural sites.

The Rock Pigeon (*Columba livia*) is the commonest among the pigeon and dove species in the Gaza Strip. It is commonly recorded in flocks; sometimes containing various colors. The colored flocks of the Rock Pigeon, seen in the Gaza Strip, indicate their content of Feral Pigeons (*Columba livia domestica* Gmelin, 1789), which refer to the

pigeons that are derived from the Domestic Pigeon (*Columba livia domestica*) but have returned to the wild. The color of the Rock Dove is generally pale grey with two black bars on each wing, whereas the color of Domestic and Feral Pigeons has noticeable variations. It is worth mentioning that the wild, feral and domestic pigeons are all the same species and can readily interbreed. Feral Pigeons are now largely present with naturalized populations of the Rock Dove in Lebanon (Ramadan-Jaradi and Ramadan-Jaradi, 2012) and all over the world (Lever, 2005). The occurrence of feral populations (sometimes known as Street Pigeons in Europe) in and around cities and towns worldwide can be harmful to human health, agriculture, and properties (Haag-Wackernagel, 1995 and Buijs and Van Wijnen, 2001). Such an occurrence was attributed by Haag-Wackernagel (1995) to food resources and human buildings as key ecological factors. Although the damage of pigeons to agricultural crops have never been realized or estimated in the Gaza Strip, Johnston and Janiga (1995) attributed the pest nature of Feral Pigeons worldwide to the characteristics of pigeons, such as being a granivore, having an alimentary storage crop, high reproductive rate, colonial habits and group foraging. A great deal of bird fauna species, including the pigeon and dove species of the current study, are hunted in the Gaza Strip for meat, game, rearing, and trade purposes.

The hunting of bird fauna, including above all pigeons and doves, for similar purposes is not restricted to the Gaza Strip and was documented in many developing and developed countries worldwide (Yom-Tov, 2003; Eid *et al*., 2011; CABS and LEM, 2013; Eid, 2013; Aloufi and Eid, 2014; Brochet *et al.,* 2016; Eason *et al.,* 2016; Raine *et al.,* 2016 and Eid and Handal, 2018). The Turtle Dove (*Streptopelia turtur*), which is recognized as a globally threatened species (Brochet *et al.,* 2016 and Dunn *et al.,* 2017), plays an important role as a game bird during the hunting seasons in Greece (Bakaloudis *et al.,* 2009). Also, Schulz *et al.,* (2013) confirmed the overharvest of the Mourning Dove (*Zenaida macroura*) as an important game bird in the USA. The occurrence of the Namaqua Dove (*Oena capensis*) in the Gaza Strip, which is overcrowded and highly urbanized, seems to be described as low.

This could be attributed to its preference to more wild habitats in addition to its new occurrence and probable breeding in the Gaza Strip. According to Abd Rabou (2019b), the species was rarely encountered in Al-Mawasi ecosystem, which is a unique coastal ecosystem in southern Gaza Strip. Most of the observed Namaqua Doves throughout the current study came from zoos, pet shops, and animal trade markets. Similar results were revealed in Lebanon, where a few individuals of the species were seen in the wild and were thought to be possible escapees from cages (Ramadan-Jaradi and Ramadan-Jaradi, 2012). Even in the Middle East entities and countries, the reports dealing with the occurrence and breeding biology of the Namaqua Dove are new and sometimes not fully clear (Shirihai and Gellert, 1989; Jennings, 2000; Haraldsson, 2008; Salim, 2008 and Hering *et al.,* 2015).

Three out of the four species of the genus *Streptopelia* that occur in the natural, semi-natural and human-made ecosystems of the Gaza Strip (Table 1) were stated to occur in the northern governorates of Palestine (i.e. the West Bank) (Khalilieh, 2016). The exception here is the African Collared Dove (*Streptopelia roseogrisea*) which has some analogous features with the Eurasian Collared Dove (*Streptopelia decaocto*) to the extent that many Palestinians consider the two species as one species under the name of Collared Dove. The rare existence of the African Collared Dove in the southern governorates of Palestine (i.e. the Gaza Strip) can be attributed to the proximity of the Gaza Strip to Egypt and Africa. The African Collared Dove was recorded among the dove species of the Negev Desert of southern Palestine. Yosef *et al.* (2004) pointed out that a few individuals belonging to the African Collared Dove were identified in a big catch of the Eurasian Collared Dove in the Eilat area, in the south. The continuous records of doves in the Gaza Strip, which is very populated,

may be attributed to the fact that doves feed primarily at man-made sites and infrequently at natural sites. Such an explanation coincides with the findings of Bergier *et al.* (1999) and Browne and Aebischer (2003) concerning the ecology and foraging of many *Streptopelia spp.* in Morocco and Britain respectively.

The Barbary Dove (*Streptopelia risoria*) is a well-known dove species among bird fanciers in the Gaza Strip. They have bred them in a great variety of colors as can be seen in the cages or aviaries harboring them in local zoos, pet shops, and animal trade markets. Some of doves noted may carry a mutation that makes them completely white either with or without a black collar on the neck. The number of colors of the Barbary Dove can be attributed to the interbreeding of the species with the afore-mentioned Eurasian and/or African Collared Doves (*Streptopelia decaocto* and *Streptopelia roseogrisea*). It appears that it can hybridise freely with either species. A reasonable assumption could be that the Barbary Dove is a domesticated form of the Eurasian or African Collared Doves (Smith, 1987 and Grouw, 2018). Feral populations of Barbary Doves establish themselves readily as a result of escapes or releases from captivity. This may interpret the occurrence of the species in many urbanized or even agricultural ecosystems within the Gaza Strip. The species is a common caged and traded bird in many countries worldwide (Eid *et al.,* 2011 and Kabir, 2019). In Lebanon, the species was recorded in the Pine Forest and the campus of the American University of Beirut where it lives together with the Eurasian Collared Dove (Ramadan-Jaradi and Ramadan-Jaradi, 2012).

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Potter Wasps (Hymenoptera: Vespidae, Eumeninae) as Hosts of *Amobia* Robineau–Desvoidy, 1830 (Diptera: Sarcophagidae, Miltogramminae) in Ukraine

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Abestract: *Amobia signata* (Meigen, 1824) was reared from the nests of eumenine wasps *Symmorphus bifasciatus* (Linnaeus, 1761), *Discoelius zonalis* (Panzer, 1801), and *Amobia oculata* (Zetterstedt, 1844) from *S. bifasciatus* in Ukraine. Both species of wasps are the new hosts for those flies. *A. oculata* was firstly recorded from Poltava region. All recent published data on hymenopteran hosts and the distribution of both species of flies are processed and listed.

Keywords: Potter wasps, *Amobia*, kleptoparasites, Poltava, Ukraine.

Introduction

Potter, or mason wasps (Hymenoptera: Vespidae, Eumeninae) consist of nearly 4000 species and 205 genera of solitary or semisocial insects. The species use various available cavities (such as coleopteran burrows made in wood, old nail holes etc) for the nest construction, or they themselves build underground burrows for nesting, and aerial nests on the stems of grasses and shrubs (so called "clay jugs"). Each nest includes from one to several brood cells. Predatory larvae feed on provisions (beetle larvae, caterpillars, etc.), paralyzed and transported by their parents in advance. Imagoes of all known species usually feed on the nectar and (rarely) pollen of flowering plants (Blüthgen, 1961). The genus *Amobia* Robineau-Desvoidy, 1830 contains fifteen species distributed all over continents except Antarctica from the subpolar regions to the tropics. The species of this genus are specialized in consistently attacking the nests of Vespidae and Sphecidae (sensu lato) in general, Predatory maggots feed on the food supply of the host larvae: paralized caterpillars of different Lepidoptera, larvae of beetles (mainly Chrysomelidae and Curculionidae) and sawflies (Hymenoptera), adults Diptera and spiders in the nests of hosts, but sometimes the larvae live in the solitary bees' nests (Spofford *et al*., 1989; Verves and Khrokalo, 2006).

Discoelius zonalis nests in preexisting cavities (burrows of xylophagous beetles in old trees and dry pones). Multicellular nests (3–11 cells) are linear, consisting of a row of several consecutive cells and a plug, which closes the entering. The partitions between the cells and plug are made of a paste of reconditioned tree leaves. Prey for larvae–paralyzed caterpillars of different species of Lepidoptera: Noctuidae (many species); Crambidae: *Patania ruralis* (Scopoli, 1763); Gelechiidae: *Cheimophila salicella* Hübner, 1801, *Corcyra cephalonica* (Stainton, 1866); Tortricidae: *Eupoecilia ambiguella* (Hübner, 1796), and larvae of *Pamphilius sylvaticus* (Linnaeus, 1758) (Hymenoptera: Pamphiliidae) (Budrienė, 2003).

The nests of *S. bifasciatus* are placed in the hollow stems of plants, reed roofs, disused plant galls of *Andricus kollari* (Hartig, 1843) (Hymenoptera: Cynipidae), where the female wasp constructs a number of cells, separated from each other by walls made of clay. Prey for larvae – paralyzed larvae of different species of leaf beetles (Coleoptera: Chrysomelidae): *Linaeidea aenea* (Linnaeus, 1758), *Phratora laticollis* (Suffrian, 1851), *P. vitellinae* (Linnaeus, 1758), *P. vulgatissima* (Linnaeus, 1758), *Plagiodera versicolora* (Laicharting, 1781) (Veenendaal and Piek, 1988; Blüthgen, 1961; Malyshev, 1952). *Amobia oculata*, *A. signata*

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and other species of this genus are very similar to each other habitually and their reliable determination is possible only by peculiarities of male postabdomen. Senior authors made a lot of efforts to establish the actual determination of these species and eliminate taxonomic confusion in all available publications (see references). The present results show only verified detailed data about food composition of wasp larvae, observation administrative territories[1], etc.

Materials and Methods

The nests of the wasps *Discoelius zonalis* (Panzer, 1801) and *Symmorphus bifasciatus* (Linnaeus, 1761) were selected as objects for the study. The field studies took place at bushes and meadows in Poltava Region, Pyriatin District, Leliaky village, 50°18'N, 32°31'E. Laboratory investigations of the hymenopteran nests were performed at the Faculty of Biology, Kyiv Taras Shevchenko National University, and the determination of the flies – took place at the Institute for Evolutionary Ecology, National Academy of Sciences of Ukraine, Kyiv.

Both species are able to nest in artificial reed nests. Such nests were installed to attract the hymenopteran insects. They were bound in bunches of trimming hollow stems of cane, *Phragmites australis* (Cav.) Trin. ex Steud., 1841, elderberry or raspberry of 25 cm long and 4 to 9 mm in diameter. The nests were established during May and June on different substrates, and were collected in October for further study under laboratory conditions. The study of the nests, and their structure, and the species composition of settlers were conducted in laboratory conditions in winter. A cane stem was cut along by a stationery knife. After full opening, each nest was sketching out in the form of a full-size scheme on a separate sheet of paper. Measurements were made using calipers. The insect cocoons were removed from the scattered reed and were placed in Eppendorf's tubes, of a 2 ml volume, closed with a thick cotton swab, and were provided with the number of the nests and the cells. The Eppendorf's tubes were kept at room temperature. Adults emerged from the cocoons in late May – June. The newly-emerged imagoes were mounted on pins for further identification. Dry individuals were pre-placed in desiccators for soaking moisture.

1The faunistic data missing from the catalog (Pape, 1996) are shown in bold.

Results

Amobia oculata[2] (Zetterstedt, 1844)
Synonym: *Pachyophthalmus distortus* Allen, 1926.
Material examined: 1♂1♀, and 2 ♂, bred from two nests of *Symmorphus bifasciatus*.

Distribution

Nearctic: Canada: British Columbia (Allen, 1926), Labrador (Allen, 1926), New Brunswick (Allen, 1926), Ontario (Criddle, 1927); USA: Arizona (Pape, 1996), California (Pape, 1996), Colorado (Pape, 1996), Georgia (Allen, 1926), Kansas (Byers, 1962), Maine (Pape, 1996), Maryland (Allen, 1926), Minnesota (Allen, 1926), Missouri (Rau, 1928), New Hampshire (Allen, 1926), New York (Allen, 1926), North Carolina (Pape, 1996), Pennsylvania (Allen, 1926), Wisconsin (Medler, 1965), Wyoming (Evans, 1973).

Palaearctic: Algeria (Séguy, 1941); Belarus (Verves, 1986); Croatia (Pape, 1996); Czech Republic: Bohemia (Povolný and Verves, 1997), Moravia (Jacentkovský, 1941); Estonia (Draber-Monko, 1966); Finland (Pohjoismäki and Kahanpää, 2014); Germany (Verves, 1986); Italy: mainland (Verves, 1986); Japan: Hokkaido, Honshu, Kyushu, Tsushima Is. (Kurahashi and Kakinuma, 2015); Kazakhstan (Verves, 1984); Lithuania (Pakalniškis and Podénas, 1992); Mongolia (Rohdendorf and Verves, 1980); North Korea (Verves, 1986); Norway (Rognes, 1986); Poland (Draber-Mońko, 2007); Russia: *European part*: Leningrad (Stackelberg, 1962), Rostov (Minoranski *et al.*, 1970), Voroniezh (Khitzova, 1967), *West Siberia*: Altai (Verves and Khrokalo, 2006); *East Siberia*: Chita (Kolomietz, 1966), *Far East*: Amur (Artamonov, 1993), Khabarovsk (Verves and Khrokalo, 2006), Primorie (Khitzova, 1977); Slovakia (Čepelák, 1986);

2 Firstly recorded from the Poltava region.

Spain (Carles-Tolrá, 2002); Sweden (Verves, 1986); Turkey (Kara and Pape, 2002); Ukraine: Cherkasy (Verves, 1998), Chernigiv (Stackelberg, 1962), Dnipro (Verves, 1975, 2000), Donetzk (Minoranski *et al.,* 1970), Kyiv (Verves, 1975), Poltava[1].

Oriental: Nepal (Pape, 1996); Taiwan (Kurahashi, 1974).

Comments: The faunistic data from China on "*Amobia oculata*" sensu Fan & Pape, 1996: 138, are really on *Amobia quatei* Kurahashi, 1974 (Zhang *et al.,* 2011).

Data on hymenopterean hosts (in list)[3]

Vespidae (Eumeninae)

Ancistrocerus adiabatus (Saussure, 1853) [Evans, 1973; Krombein, 1967; Pickering, 2009, as "*Ancistrocerus adiabatus adiabatus* (Saussure)"].

A. antilope (Panzer, 1789) [Ashmead, 1894; Fateryga, 2013; Krombein, 1967, 1979; Pickering, 2009, as" *Ancistrocerus antilope antilope* (Pz.)"].

A. catskill (Saussure, 1853) [Buck *et al*., 2008; Fye, 1965; Krombein, 1967, 1989].

A . flavomarginatus (Brethes, 1906) [Yamane, 1990].

Anterhynchium flavomarginatum (Smith, 1852) [Itino, 1986, 1988, 1992, 1997]

A. micado (Kirsch, 1873) [Kurahashi, 1973 (as "*Anterhynchium flavomarginatum micado* Kirsch"; Yamane, 1990].

Eumenes fraterculus Dalla Torre, 1941 [Iwata, 1978; Yamane, 1990].

E. rubrofemoratus Giordani Soika, 1941 [Kurahashi, 1973; Yamane, 1990].

E. rubronotatus Pérez, 1905 [Yamane, 1990].

Euodynerus dantici (Rossi, 1790) [Blüthgen, 1961; Buyanjargal & Abasheev, 2015; Itino, 1988, 1992; Iwata, 1976].

E. leucomelas (Saussure, 1855) [Buck *et al.,* 2008; Fye, 1965; Krombein, 1989; Pickering, 2009; Richards, 1978].

Orancistrocerus drewseni (Saussure, 1857) [Itino, 1986, 1988, 1992,1997; Iwata, 1982].

Oreumenes decoratus (Smith, 1852) [Kurahashi, 1973, as "*Eumenes decoratus* Smith"; Yamane, 1990].

Pachodynerus nasidens (Latreille, 1812) [Rosenheim, 1990].

Pararrhynchium ornatum (Smith, 1852) [Itino, 1988, 1997].

Rhynchium fukaii Cameron, 1911 [Kurahashi, 1973, as „*Rhynchium haemorrhoidale fukaii* Cameron"; Yamane, 1990].

Stenodynerus frauenfeldi (Saussure, 1867) [Iwata, 1963, 1980; Kurahashi, 1973; Yamane, 1990].

Symmorphus albomarginatus (Saussure, 1855) [Krombein, 1967].

S. captivus (Smith, 1873) [Kurahashi, 1973].

S. crassicornis (Panzer,1798) [as „*Odynerus crassi*cornis": Draber-Mońko, 1964, 1966; Mihályi, 1979].

S. cristatus (Saussure, 1853) [Evans, 1973; Krombein, 1967; Pickering, 2009, as "*Symmorphus cristatus cristatus* (Saussure)"].

Apoidea (Sphecidae, sensu lato**)**

Ammophila sabulosa (Linnaeus, 1758) [Artamonov, 1988; Casiraghi *et al*., 2001; Field, 1992a, b; Pulawski, 2020].

Cerceris halone Banks, 1912 [Byers, 1962, 1978; Jobin and Perron, 2009; Krombein, 1958].

Ectemnius lapidarius (Panzer,1804) [Hamm and Richards, 1926; Lomholdt, 1975, 1976].

E. stirpicola (Packard, 1866) [Krombein, 1960; Srba, 2010].

Isodontia (*Murrayella*) *mexicana* (Saussure, 1867) [Medler, 1965; Pickering, 2009, as "*Sphex apicalis* Sausurre"; Pulawski, 2020].

Rhopalum clavipes (Linnaeus, 1758) [Lomholdt, 1984; Pakalniškis and Podénas, 1992].

Sceliphron destillatorium (Illiger, 1807) [Gorobchishin, 2005;___Mader, 2013; Minoranski, 1971; Minoranski *et al.,* 1970].

Trypoxylon clavatum (Say, 1837) [Krombein, 1967; Pickering, 2009; Srba, 2010].

T. figulus (Linnaeus, 1758) [Pakalniškis and Podénas, 1992].

T. frigidum Smith, 1856 [Evans, 1973, as "*Trypoxylon aldrichi* Sandhouse, 1940"; Krombein, 1967, as "*Trypoxylon aldrichi* Sandhouse, 1940"; Medler, 1967; Pickering, 2009, as "*Trypoxylon frigidum frigidum* Smith"; Srba, 2010].

T. lactitarse Saussure, 1867 [Krombein, 1967; Medler, 1967; Pickering, 2009].

T. obsonator Smith, 1873 [Kurahashi, 1973; Srba, 2010].

3. Author(s) and year of publication are shown in square brackets.

T. petiolatum Smith, 1858 [Kurahashi, 1973].
T. politum Say, 1837 [Allen, 1926; Downing, 1996; Pickering, 2009; Rau, 1928; Srba, 2010].
T. regium Gussakovskij, 1932 [Srba, 2010].
T.striatum (Provancher, 1888) [Srba, 2010].

Amobia signata (Meigen, 1824)
Material examined: 2♂2♀, and 1♂3♀, bred from two nests of *Symmorphus bifasciatus*; 1♂ bred from nest of *Discoelius zonalis*.

Distribution

Palaearctic: Algeria (Verves, 1986); Armenia (Verves, 1980); Austria (Verves, 1986); Azerbaijan (Verves, 1980); Belgium (Verves, 1986); Bulgaria (Verves, 1986); Canary Is. (Becker, 1908); China: Beijing (Zhang *et al.,* 2011), Shaanxi (Fan and Pape, 1996), Sichuan (Fan and Pape, 1996), Xinjiang (Chao and Zhang, 1998); Croatia (Szpila, 2010); Cyprus (Verves, 1986); Czech Republic: Bohemia (Povolný, 1997), Moravia (Jacentkovský, 1941); Denmark (Lundbeck, 1927); Finland (Tiensuu, 1939); France: mainland & Corsica (de Jong *et al*. 2014; Séguy, 1941); Germany (Meigen, 1824); Greece (de Jong *et al*. 2014); Hungary (Mihályi, 1979); Italy: mainland (Bezzi, 1895), Sardinia (Raffone, 2009), Sicily (Raffone, 2009); Japan: Honshu (González *et al*., 2004); Kazakhstan (Verves, 1986); Kyrgyzstan (Verves, 1986); Libya (Venturi, 1960); Lithuania (Valenta and Podenas, 1985); Macedonia (Coe, 1960); Malta: Malta I. (Schembri *et al*., 1991); Moldova (Verves, 1986); Mongolia (Rohdendorf and Verves, 1980); Morocco (Séguy, 1941); Poland (Draber-Mońko, 2007); Romania (Verves, 1986); Russia: *European part*: Voroniezh (Skufyin and Khitzova, 1967), *North Caucasus*: Checnia (Verves, 1980), Ingushetia (Verves, 1980), Karachai-Cherkesia (Khitzova, 1977), *East Siberia*: Chita (Rohdendorf and Verves, 1980), *Far East*: Primorye (Khitzova, 1977); Serbia (Szpila, 2010); Slovakia (Povolný, 1997); Slovenia (Szpila, 2010); Spain (Séguy, 1941); Sweden (Enslin, 1922); Switzerland (Pape and Merz, 1998); Tajikistan (Gajei, 1963); The Netherlands (de Jong *et al*. 2014); Tibet (Zhang *et al.,* 2011); Tunisia (Pape, 1996); Turkey (Kara and Pape, 2002); Turkmenistan (Verves, 1986); Ukraine: Cherkasy (Verves, 1998), Chernigiv (Verves and Khrokalo, 2014), Crimea (Fateryga and Ivanov, 2009), Kharkiv (Yaroshevski, 1882), Kyiv (Verves, 1998), Poltava (Yaroshevski, 1882), Zakarpattia (Verves and Khrokalo, 2018); United Kingdom (Emden, 1954); Uzbekistan (Verves, 1986).
Oriental: India: Jammu & Kashmir (Pape, 1996).
Comments: The faunistic data from Albania on "*Amobia signata*" sensu Pape, 1996: 74, are really on *Amobia oculata* (Kara and Pape, 2002).

Data on hymenopterean hosts (in a list).
Vespidae (Eumeninae)

Allodynerus delphinalis (Giraud, 1866) [Enslin, 1922; Lundbeck, 1927].
Ancistrocerus Wesmael, 1836, sp. [Myers, 1927].
A. auctus (Fabricius, 1793) [Verves and Khrokalo, 2014].
A. gazella (Panzer, 1798) [Deeming, 1985; Harris, 1994].
A. nigricornis (Curtis, 1826) [Chevalier, 1923a, b, as "*Odynerus callosus* Th."; Verves and Khrokalo, 2014].
A. parietinus (Linnaeus, 1761) [Weis, 1960].
A. parietum (Linnaeus, 1758) [Chevalier, 1923a, b].
Discoelius zonalis (Panzer, 1801) [Chevalier, 1923a, b].
Eumenes Latreille, 1802, sp. [Chevalier, 1923a, b].
E. pomiformis (Fabricius, 1781) [Séguy, 1941].
Euodynerus disconotatus (Lichtenstein, 1884) [Verves and Khrokalo, 2014].
E. notatus (Jurine, 1807) [Pekkarinen, 1988].
E. quadrifasciatus (Fabricius, 1793) [Pekkarinen, 1988].
Gymnomerus laevipes (Shuckard, 1837) [Fateryga, 2012; Verves and Khrokalo, 2014].
Katamenes flavigularis Bluethgen, 1951[Fateryga and Ivanov, 2009; Verves and Khrokalo, 2014].
Odynerus reniformis (Gmelin, 1790) [Lundbeck, 1927; Malyshev, 1911].
O. spinipes (Linnaeus, 1758) [Pape, 1987].
Synagis Latreille, 1802, spp. [Bequaert, 1918].

Apoidea (Sphecidae, sensu lato**)**

Cerceris rybyensis (Linnaeus, 1771) [Else, 1998].

Clytochrysus lapidarius (Panzer, 1803) [Séguy, 1941].

C. ruficornis (Zetterstedt, 1838) [Séguy, 1941].

Chalibyon spinolae (Lepeletier de Saint Fergau, 1845) [Srba, 2010].

Crossocerus Lepeletier & Brullé, 1834, sp. [Srba, 2010].

C. walkeri (Shuckard, 1837) [Lomholdt, 1984; Richards, 1980; Séguy, 1941, as "*Coelocrabro walkeri* Th."].

Ectemnius Dahlbom, 1845, sp. [Pape, 1987].

E. lapidarius (Panzer, 1803) [Séguy, 1941, as "*Clytochrysus chrysostomus* (Lep.)"].

E. ruficornis (Zetterstedt, 1838) [Séguy, 1941, as "*Clytochrysus planiofrons*"].

Lionotus delphinaris (Giraud, 1866) [Lundbeck, 1927].

Mimumesa atratina (Morawitz, 1891) [Lomholdt, 1984; Srba, 2010].

Odynerus Latreille, 1802, sp. [Malyshev, 1911].

O. reniformis (Gmelin, 1790) [Lundbeck, 1927].

O. spinifes (Linnaeus, 1758) [Pape, 1987].

Pemphredon Latreille, 1796, sp. [Bezzi, 1907; Baer, 1921; Lomholdt, 1984; Lundbeck, 1927; Srba, 2010].

P. lugubris (Fabricius,1793) [Chevalier, 1923a, b; Lomholdt, 1984; Séguy, 1941; Srba, 2010].

P. rugifer (Dahlbom, 1844) [Séguy, 1941, as "*Cenomus unicolor* Fab."]

Pison insigne Sichmann, 1894 [Antropov, 1990].

Psenulus sp. [Srba, 2010].

Psenulus pallipes (Panzer, 1798) [Bitsch *et al.* 2001; Chevalier, 1925, as "Psenulus atratus F."; Lomholdt, 1984; Séguy, 1941, as " *Psen atratulus* Latr.."].

Sceliphron caementarium (Drury, 1773) [Campadelli, 1984; Campadelli *et al.*, 1999].

S. destillatorium (Illiger, 1807) [Campadelli and Pagliano, 1987; Mader, 2013].

S. spirifex (Linnaeus, 1758) [Séguy, 1941; Srba, 2010].

Trypoxylon albitarse Fabricius, 1804 [Lundbeck, 1927 ; Srba, 2010].

T. attenuatum Smith, 1851 [Gorobchishin, 2006; Lefeber, 1979; Séguy, 1941; Srba, 2010].

T. clavicerum Lepeletier & Serville, 1825 [Gorobchishin, 2006; Kazenas, 1987; Lefeber, 1979; Lomholdt, 1975, 1984].

T. figulus (Linnaeus, 1758) [Séguy, 1941; Srba, 2010].

Apoidea (different bees)

Andrena cineraria (Linnaeus, 1758) [Grobov *et al.*, 1988; Séguy, 1941].

A. fulvida Schenck, 1853 [Grobov *et al.*, 1988; Séguy, 1941].

A. haemorrhoa (Fabricius, 1781) [Grobov *et al.*, 1988; Séguy, 1941, as"*Andrena albicans* L."].

Megachile centuncularis (Linnaeus, 1758) [Grobov *et al.*, 1988; Séguy, 1941].

M. rotundata (Fabricius, 1793) [Grobov *et al.*, 1988; Pape, 1987].

Eucera atricornis (Fabricius, 1793) [as"*Osmia atricornis*": Grobov *et al.*, 1988; Séguy, 1941].

Osmia rufa (Linnaeus, 1758) [Grobov *et al.,* 1988; Séguy, 1941].

Protandrena atricornis (Cresson, 1878) [Séguy, 1941, as "*Osmia atricornis* Latr."].

Discussion

As a result, from the recent analysis of the types of trophic connections of *Amobia* larvae it seems that they may be predators of paralyzed arthropods (in the nests of the majority of wasps), necrophages (in nests of wasps with fleshly killed arthropods) or nectarophages and polllinophages (in bee nests). All these types of food can pass into each other; thus, the first stage larvae in the nests of bees first kill the host egg, and only then begin to eat the pollen loaf ("bee bread") (Verves, 1984; Wcislo, 1987). As a rule, in wasp nests provisioned by paralyzed insects or spiders maggots they began feeding as predators, but finished larval development as necrophages. In general, the species of the genus *Amobia* are not very choosy in the selection of hosts for the variety of stored food, but they are clearly specialized for development in clay "jugs" or nests inside hollow stems. A broader

discussion of the results is currently difficult due to fragmentation of data on the ways of invasion of hymenopteran nests by flies, the full spectrums of maggots' feeding, the host range, and other important aspects of the biology of the genus *Amobia*.

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Short Communication

An Additional Locality Record of the Blotched Rat Snake, *Elaphe sauromates* (Pallas, 1814) (Reptilia: Colubridae) in Syria

Ahmad Qawi [1], Nazir Khalil [1, 2] and Zuhair S. Amr [3*]

Abstract: The present note provides an additional locality record of the rare Blotched Rat Snake, *Elaphe sauromates* (Pallas, 1814) from Syria. An updated map of its current distribution across Syria and Lebanon is presented.

Keywords: Syria, *Elaphe sauromates,* locality record.

The range of the distribution of the Blotched Rat Snake, *Elaphe sauromates* (Pallas, 1814), extends from southeastern Europe (Bulgaria, Greece, and Romania), Moldova, southern Russia, the Ukraine, Turkmenistan, western Turkey, Syria and Lebanon (Sindaco *et al*., 2013; Jablonski *et al*., 2019). The first record of this species is from Majdal Shams, on the southern slope of Mt. Hermon. One further specimen was collected in 1978 from Camp Fauar near Al-Quneitra (Tiedemann and Häupl, 1978; Berger-Dell'mour, 1986). In addition, it was reported by Esterbauer (1992) between 4 Km W Hadar and 2 Km S Halas.

On May 22, 2020, at 15:20, an adult *Elaphe sauromates* with a total length of approximately 150 cm was observed and photographed by a group of hikers led by Ahmad Qawi at a mountainous area in the countryside near Halboun (altitude 2200 m a.s.l.), about 30 km NW Damascus (Figure 1).

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Its habitat consisted of rocky hills of eroded soil with a very sparse typical Sub-Alpine steppe vegetation of short grass (*Bromus* sp. and *Geranium* sp.) perennials (*Ferula hermonis, Nepeta* sp. and *Cousinia* sp.) and cushioned-form shrubs (mostly *Acantholimon ulicinum*, *Astragalus hermoneus*, *Cerinthe minor* and *Marrubium libanoticum*), in addition to a few scattered bushes of Greek Juniper (*Juniperus excelsa*). Two other species of reptiles (*Stellagama stellio* and *Phoenicolacerta kulzeri*) were also reported in the area.

The specimen is characterized by intense dark pigmentation on the top of the head and body. Upper 1-7 and all lower labials are covered with light yellow coloration. Dorsal scales keeled arranged in longitudinal rows and separated by yellow-white background. Ventral scales are light yellow (Figure 2). A specimen at the Natural History Museum at Vienna (NMW 23472), collected from near Al-Quneitra, has the following measurements: Snout-Vent length 117 cm, Tail length 26 cm. Mid-body scales 26, ventral scales 208, caudal scales 70 (Tiedemann and Häupl, 1978). Although work on the herpetofauna of Syria is fragmentary (Disi and Böhme, 1996; Lymberakis and Kalionzopoulou, 2003; Sindaco *et al*., 2006), the Blotched Rat Snake appears to be extremely rare from the few existing studies. The current work represents the fourth record of this species in Syria over the past forty years.

This species reaches its most southern range of distribution in southwestern Syria

Figure 1. Habitat of *Elaphe sauromates* in Halboun area.

Figure 2. *Elaphe sauromates* from Halboun, Syria (Photo by Omar Sanadiki).

and the western mountains of Lebanon (Figure 3). It was reported from the southern slopes of Mt. Hermon (In Den Bosch *et al.*, 1998) and from the cedar forests of Barouk and Niha cedar of grove (Hraoui-Bloquet *et al.*, 2002). Its distribution along the coastal mountains of Syria is highly probable since it represents a continuation to the southwestern population of this snake in Turkey.

The southern distribution of *Elaphe sauromates* in Syria shows that it represents a relict species. The populations of this species are located in certain areas similar to their original habitat and are separated from each other by some distances. These separated populations are sensitive to ecological changes including mainly their habitat destruction (Disi, 2002). The cryptic species, *Elaphe urartica,* has been recently described in Azerbaijan, Armenia, Georgia, northern Iran, and eastern Turkey (Jablonski *et al.*, 2019); thus, the previous range of the distribution of *Elaphe sauromates* should be reconsidered.

Further studies on this rare species in Syria need be conducted, specifically in relation to its biology, distribution, and phylogenetic relationship with other populations within its range of distribution.

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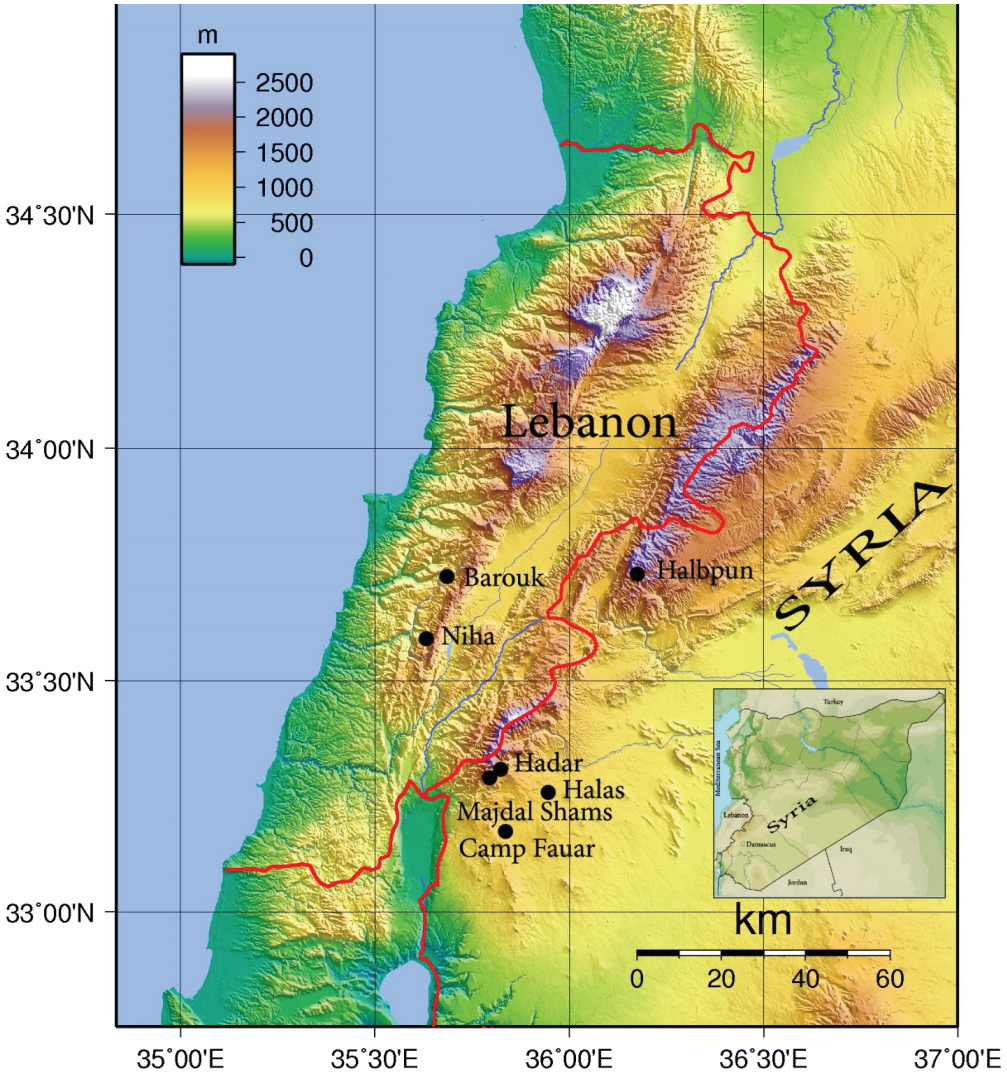

Figure 3. Distribution of *Elaphe sauromates* in Syria and Lebanon.

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Short Communication

A Recovery of a Lanner Falcon *Falco biarmicus* Suggesting a Possible Movement Pattern in the Jordan's Breeding Population

Mohammed Al Zoubi* , Ashraf El-Halah, and Nashat A. Hamidan

Abstract: The numbers of raptors admitted to the Royal Society for the Conservation of Nature's (RSCN) Rehabilitation Center have increased over the past decade, with a total of 140 raptors treated, ringed and released. Among these raptors is the Lanner Falcon *Falco biamicus*, which had been ringed and released on the third of August, 2017, after spending nearly 580 days in the Rehabilitation Center. 445 days following its release, a telephone call from a falconer was received confirming the capture of this individual Falcon in Al Hafirat, Madinah Province, Saudi Arabia, nearly 850 km away from the released site. This piece of information suggests the occurrence of a possible movement pattern of this species. The confiscation of juveniles' lanner falcons over the past four years indicates that a possible breeding population still exists in Jordan. However, more detailed surveys are needed to confirm its breeding in Jordan in addition to modern tracking technology to determine the movement patterns of the species.

Keywords: Rehabilitation, Ringing, Saudi Arabia, Confiscation, Recovery.

Introduction

The lanner Falcon *Falco biarmicus* (F. b) is considered as an Afrotropical/Palearctic species and its range of distribution extends from southern Europe, covering former Yugoslavia, Italy, and Greece in the west and across Georgia, Armenia, Azerbaijan eastwards, including northern Iran, and southwards across the Middle East and the Arabian Peninsula (del Hoyo, and Collar 2014; Global Raptor Information Network 2020). In Africa, the species has been found throughout the continent except for in the equatorial region, patchily through northern Africa, and from Senegal and Gambia eastwards to Ethiopia and Sudan and southwards through East Africa and western and northern Angola down to the south in most South Africa (Global Raptor Information Network. 2020). Among the five subspecies that were recognised within its distribution range, the subspecies *F. b. tanypterus* is known to be found in the regions extending from north-east Africa to Sudan, Jordan, Iraq, and into the Arabian Peninsula (Jennings 2010; del Hoyo and Collar 2014). In Yemen, the subspecies *F. b. abyssinicus*, best known in Sahel Zone, Ethiopia and Somalia, was collected from an area near Lahij (Jennings 2010).

According to the IUCN Red List assessments, the species is globally considered as a Least- Concern (LC) species. However, regional assessments of the European and the Arabian Peninsula populations showed severe declining in its population, therefore, the species must be considered as Endangered (EN) in Europe (BirdLife International 2016) and as a Critically-Endangered (CR) species in the Arabian Peninsula (Symes et al. 2015). Most of the Lanner Falcon populations are resident, although some migration movements have been recorded locally in West Africa (Thiollay 2006). In the east and south-western populations, nomadism was

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recorded (del Hoyo et al., 1994; Ferguson-Lees and Christie 2001). In southern Africa, the species is partially migratory, which means that some birds involve in some sort of migration movement, others are resident (van Zyl et al.. 1994). Moreover, immature birds showed mobility more than adults, with the extent of migration varying with environmental conditions, especially rainfall patterns and their effects on prey abundance (Jenkins 1997). Ferguson-Lees and Christie (2001) described some dispersion patterns especially by juveniles and some adults including a southward movement for breeding especially in the Middle East; they also reported north-south movements in Africa.

In Jordan, this species is considered as a passage migrant and winter visitor, with few records of breeding pairs in the country (Andrews, 1995, Snow and Perrins 1998). However, according to Symes et al. (2015), no recent breeding record has been found in Jordan. Unfortunately, the movements of this species are poorly studied. However, this short communication, gives an idea about the possible migration movement of the Lanner Falcon which is probably breeding in Jordan.

Rehabilitation Centre

Among the principal obligations of the Royal Society for the Conservation of Nature (RSCN) is to provide care and rehabilitation for injured and confiscated animals and birds. Therefore, the Rehabilitation Center was established in 2008 by the RSCN. Despite being in operation for more than ten years now, the Rehabilitation Center started to conduct the necessary systematic documentation of raptors only five years ago, during which more than 140 raptors were admitted to the center (Al Zoubi et al., 2020). Five causes for this admission have been identified by Al Zoubi et al. (2020 In. press) as: illegal possession, malnutrition, orphaned young, trauma, and infectious diseases. When received, these birds are usually evaluated and kept for rehabilitation. If they are recently captured from the wild with no signs of illness, they will be immediately released. The duration of rehabilitation of the confiscated birds varied over the past five years from one day to 580 days (Av. 53.72). The longest stay in rehabilitation before release was for a Lanner Falcon *Falco biarmicus*. The Center had also received confiscated Lanner Falcon' chicks during 2015, 2017, and 2018.

Health Status and Treatment

The Lanner Falcon (Figure1) was confiscated on January 1, 2016 by the environmental police unit, the Royal Rangers, after being offered for sale on social media. Upon time of confiscation, the falcon was found to be one-year old, and had broken primaries, early stage bumblefoot, and suffered from general weakness. The bird was kept at the RSCN's Rehabilitation Center for 580 days, where it received treatment for bumblefoot following the procedures of (Remple, 2006). Afterwards, the bird went through intensive training for flying and its weight was carefully monitored. Three months before its release, the bird was kept free, and was isolated in a large aviary (10 m long, 5 m width, 3 m hight), while being fed with living quails and pigeon for the last week of stay before release.

Release and Recovery

Following the RSCN's releasing protocol, the bird was ringed with the RSCN ring (serial number: B0052), and was released on the 3rd of August, 2017 at the confluence point between Mujib and Hidan River in southern Jordan (lat: 31.450602, Lon: 35.599888).

On October 22, 2018 (445 days later), the authors received a phone call from Saudi Arabia informing the Center that a Lanner Falcon holding the same ring was captured in Hafirat Al-Aida site (lat: 26.434224, Lon: 39.260922) at Al Madinah Al Monawara province, Saudi Arabia. The place where it was captured is located around 850 km south of the releasing site. This suggests that some sort of movement or dispersion of this species has occurred in Jordan. Similar movement patterns were recorded for the

African populations as ringed birds in South Africa were found 695 and 1200 km away from the release sites (Global Raptor Information Network. 2020). The authors had asked the trapper to release the bird for the purpose of research; however, no further information was available afterwards concerning this bird.

In regard to the Saudi Arabian population, the Lanner Falcon is known to be formally breeding in Hijaz and the eastern province (Jennings 2010). In 2015, a large survey was carried out in the Kingdom of Saudi Arabia to identity active nests at former breeding sites and locations known by falcon trappers. Sadly, no breeding pairs or active nests were found (Bin Othman 2016). According to Jennings (2010), there is also a migrant and wintering population.

However, the species is traditionally used by Arab falconers; therefore, the species was targeted by falcon trappers (Bin Othman 2016; Shobrak 2015). This activity probably represents the most critical threat to the species in the Arabian Peninsula.

In conclusion: the confiscation of Lanner Falcon chicks over three seasons suggests that the species is probably still breeding in Jordan; however, this needs more investigation. The recovery event of the Lanner Falcon proves that the species is dispersing southwards, similar to other populations in Africa. This finding is encouraging for further satellite tracking research in order to identify its movement patterns, and to determine the status of this species in the country. These acts will probably help work out a proper species conservation plan, which takes into consideration programs for raising awareness among trappers and falconers to support the conservation of the species in Jordan.

Figure 1. The Lanner Falcon at the releasing site © Hamidan, 3rd August, 2017.

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Short Communication

The First Record of a Bat Found Ensnared by a Plant in the Occupied Palestinian Territories

Elias N. Handal* and Mazin B. Qumsiyeh

Abstract: This is the first documented record of a bat ensnared by a plant in the Arab world. Kuhl's pipistrelle, *Pipistrellus kuhlii* (Kuhl, 1817), was caught on the Holy Hawksbeard, *Picris altissima* L. Delile, in Bethlehem, the Occupied Palestinian Territories (West Bank).

Keywords: Bat death, West Bank, *Pipistrellus kuhlii*, *Picris*.

Causes for bats' decline include diseases, predation, and habitat destruction (Looney, 1972; Wibbelt *et al.,* 2010; Russo and Ancillotto, 2015; Amr *et al.,* 2016). Accidental deaths in animals, like in humans, should not be ignored as a cause of mortality. There is a number of reported cases in the 20th century of bats killed by being entangled on thorns of cacti or plants such as Burlock (*Actium* spp.) from North America (Hamilton, 1939; Verts, 1988; Hendricks *et al.,* 2003; Norquay *et al.,* 2010; Pigage *et al.,* 2011), from Brazil (Jacomassa *et al.*, 2017), and from Ukraine (Merzlikin, 2017). To the researchers' knowledge, there is no record of such fatality in bats from the Arab world.

Likely, due to its adaptability to human created habitats, *Pipistrellus kuhlii* is the most common insectivorous bat species in the Eastern Mediterranean region, and can be found in all habitats from arid areas to mountains with high elevations (Qumsiyeh, 1996). In April 2019, a specimen was found ensnared and mummified on the plant (Figure 1-B), Holy Hawksbeard (*Picris altissima*) in the garden of the Palestine Museum of Natural History, Bethlehem, Palestine (Figure 1-A). It seems that the bat was entangled while trying to approach the pond for the sake of feeding on insects or drinking. The echolocation data from the area showed that this species is the most common in the museum garden. Identification was based on the dental morphology and the presence of a white band on the margin of the wing (Qumsiyeh, 1996). *Picris altissima* is a member of the family Asteraceae, and is common in the Mediterranean region across varied habitats. Such mortality on plants must be low; during the studying of bats in this region for decades, no such accidental deaths of bats on plants have been reported (Qumsiyeh, 1985; Qumsiyeh, 1996). Because the numbers of all insectivorous bats in this region are declining, it is worthwhile to conduct studies on the causes of mortality of these ecologically endangered species.

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Figure 1. A: PMNH pond, the red arrow shows where the bat was found, **B:** *P. kuhlii* ensnared on *C. sancta*.

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Short Communication

Massylaea vermiculata (O. F. Müller, 1774): A Serious Land Snail Pest Introduced to Jordan

Zuhair S. Amr[1*], Mohammad Abu Baker[2] and Ahmad Katbeh- Bader[3]

Abstract: A heavy infestation of *Massylaea vermiculata* in an olive farm located in the eastern desert of Jordan is reported**.**

Keywords: *Massylaea vermiculata,* Jordan, invasive species.

Massylaea vermiculata is commonly referred to as the chocolate-band snail or noodle-snail, and was formerly known as *Eobania vermiculata* (Bouaziz-Yahiatene *et al*., 2017). The species is a circum-Mediterranean land snail known to invade all types of habitats including home gardens, plant nurseries and agricultural farms (Mienis *et al*., 2016). It is considered as one of the most widespread land snails in the Mediterranean region and has been introduced to suitable habitats in many parts of the world including arid countries as Saudi Arabia and Qatar (Neubert, 1998; Al-Khayat, 2010; Amr and Al-Shammari, 2013). It is strongly believed that it has been introduced to the Middle East through the import of ornamental garden plants from Europe (Mienis, 1973; Neubert *et al*., 2015).

The shell has a creamy-whitish background color with four or five brown to chocolate colored stripes, spotted or speckled with white dots. It has five to six whorls; peristome shiny white; umbilicus inconspicuous. The diameter size of adult specimens reaches 20-30 mm (Neubert *et al*., 2015). This snail can lay up to 60-80 eggs in the soil, and reaches maturity after two years (Ronsmans and Van den Neucker, 2016).

On June 30, 2015, it was brought to our attention by a farmer at Wādī ad Dulayl (32°06'45.62"N 36°15'15.10"E) that his olive farm was heavily infested by snails. Upon inspection, hundreds of *M. vermiculata* were found attached to olive tree trunks and twigs (Figure 1). Also, hundreds of dried snails were found around trees. All snails were of the adult stage. The following years, the problem disappeared, and no further infestation was reported. Wādī Dulayl is located east of Az Zarqāʾ. It is characterized by an arid climate with an annual rainfall not exceeding 200 mm. A possible explanation behind the snail infestation is that *M. vermiculata* gained access to the farm through seedlings containing adult snails or eggs. A similar observation was reported from the Jordan University of Science and Technology campus near Ar Ramthā. In 1994, several live specimens were collected from the campus, and then disappeared ever since (Neubert *et al*., 2015). In Egypt, *Massylaea vermiculata* snails were also found to infest fruit orchards and ornamental plants (Eshra, 2013). Other species of invasive land snails known to Jordan include: *Rumina decollata* (Linnaeus, 1758) and *Cochlicella acuta* (O. F. Müller, 1774) commonly found in home gardens and plant nurseries (Neubert *et al*., 2015). It is recommended that the Ministry of Agriculture in Jordan should implement protective measures against the invasive land snails including further inspection of any plants imported from Europe.

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Figure 1. *Massylaea vermiculata* snails on an olive tree at Wādī ad Dulayl.

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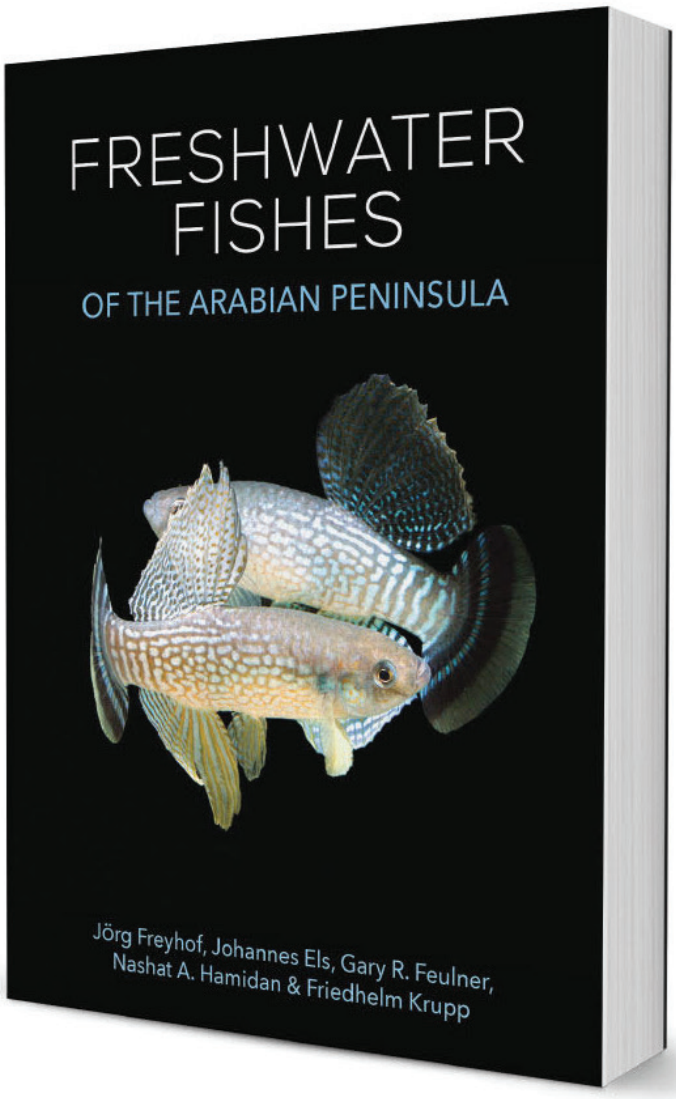

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