

## On Habitat-specific Nutritional Condition in Graceful Warblers *Prinia gracilis*: Evidence from Ptilochronology

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YOSEF, R. (1996): On habitat-specific nutritional condition in Graceful Warblers *Prinia gracilis*: evidence from ptilochronology. *J. Orn.* 139: 309–313. — Dry salt marshes of the Rift Valley in Israel are subject to development. This is of special concern because the peace process has led to a boom of financial investment and a flood of ideas as to how these areas can be further exploited. This includes Eilat, an important migratory bottleneck on the northern edge of the Saharan-Arabian desert belt, which is critical for many avian migrant species because in spring it is reached after a flight of almost 2000 km across continuous deserts. Of the once extensive Eilat salt marsh of 12 km<sup>2</sup>, all that remains today is a piece of only 0.04 km<sup>2</sup>. An avian study of this habitat concluded that the salt marsh was important for the survival of at least 70 species of migrant passerines that staged in the salt marsh. In order to evaluate the optimality of the salt marsh and reed beds for the birds I sampled a resident species as a bioindicator. I hypothesized that ptilochronology would allow me to compare between the habitats and to rank their relative importance to avian populations. During autumn 1993 and spring 1994, 59 Graceful Warblers from territories in the reeds, and 41 from the salt marsh were trapped and a central rectrix plucked for analysis. The average of 10 growth bars of the rectrix of the birds from the reeds were significantly broader than those of the salt marsh. A comparison of the two habitats clearly shows that the reed beds are a superior resource to the birds than the existing salt marsh.

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### Introduction

In most of the low-lying regions of the southern Arava Valley, Israel (part of the Syro-African Rift Valley), dry salt marshes are the dominant habitat. In Israel, this habitat is considered as wasteland and has for decades been subject to urban and agricultural development under the slogan of “making the deserts bloom”. However, little is known about the effects of development in the past on the environment in general, and the avian communities in particular. This is of special concern because the signing of the peace treaty between Jordan and Israel has led to a boom of financial investment and a flood of additional ideas as to how these areas can be further exploited (e.g. quarrying, inland ports, railways, recreational racetracks). The salt marsh habitat continues to be the target for “development” and has been steadily declining for much of the 20th century.

The once extensive Eilat salt marsh of approximately 4 km long x 3 km wide (12 km<sup>2</sup>), had shrunk to about 1.5 km x 100 m (0.15 km<sup>2</sup>) in 1986, but all that remains today in its original form is a piece of about 800 m x 50 m (0.04 km<sup>2</sup>). The

last piece was destroyed by the neighbouring Kibbutz on 20th January 1997 for as yet unclear purposes. The only avian study that relates to this habitat is an unpublished report of the Israel Nature Reserves Authority (H. SHRIHAI, unpubl., 1986). The report concluded that the local salt marsh was extremely important for the survival of at least 70 species of migrant passerines, and that use of this area for human purposes could have negative consequences for many migrant populations. The salt marsh is the terminal point for most of the local wadis when they flood in winter; the soil has a greater salt content than surrounding areas, thus having a unique plant community dominated mostly by Seablite (*Suaeda monoica*), but Nile Tamarisk (*Tamarix nilotica*), also occur (WAISFI 1984).

Approximately 25 m to the west of the remaining Eilat salt marsh is a man-made canal along which the plant community that has developed comprises almost exclusively of reeds (*Phragmites australis*), although Seablite and Tamarisk can be found in bulldozed areas. These reed beds are today used by many species of avian migrants (e. g., *Acrocephalus* spp., *Hippolais* spp., *Phylloscopus* spp.) as an alternative to the salt marsh as a feeding habitat.

At present, the Municipality of Eilat and the regional council of Eilat are considering the development of the remaining salt marsh and the adjacent canal and reed beds. The extensive human induced changes of the region are such that the decimation of these habitats would leave the migrant populations with no alternative feeding sources. In order to evaluate the suitability of the two habitats for birds I chose to sample a resident species found in both habitats, and defends territory throughout the year, as a bioindicator. These characteristics allow me to assume that the birds sampled will have molted their feathers on the territories in which they were trapped. I hypothesized that ptilochronology (GRUBB 1989) would allow me to compare between the two habitats and to infer their relative importance to avian populations. This method would also allow me to argue for the conservation of these habitats and to try and find compromises with future development plans.

## Methods

I indexed nutritional condition with the recently developed technique of ptilochronology (GRUBB 1989). Recognizing that each growth bar on a feather represents 24-hours' growth, this technique uses the width of growth bars as an index of a bird's nutritional condition at the time the feather was being grown (GRUBB & YOSEF 1994). The wider the growth bars, the better the nutritional condition at the time the feather was grown (c. g. GRUBB 1989, 1991, GRUBB & CIMPRICH 1990, WAITE 1990, WHITE & KENNEDY 1992). The assumptions and utility of ptilochronology are discussed in MURPHY & KING (1991), GRUBB (1992) and MURPHY (1992).

During autumn 1993 and spring 1994, Graceful Warblers (*Prinia gracilis palestinae*) were live-trapped at the ringing station of the International Birding Center in Eilat. The habitat in the vicinity of each capture site was recorded as either reed beds or salt marsh. Before releasing each bird at the capture site, age and sex were determined when possible, wing chord and body mass measured, and the central rectrix (R1) pulled and stored.

I determined for each feather: (1) width across 10 growth bars centered on the point two thirds of the distance from the proximal end of the feather (GRUBB 1989), (2) total length, and (3) number of fault bars on each Graceful Warbler feather as an additional potential indicator of habitat-specific nutritional condition. Fault bars are 'thin spots' on feathers caused by incomplete growth of barbuces (NEWTON 1968). They have generally been considered to indicate periods of nutritional stress during feather growth, although this assertion has recently been challenged (KING & MURPHY 1984).

Although Graceful Warblers in Israel often establish territories of their own when two months old, and appear to spend their entire adult lives on the same territory (PAZ 1978, 1987), I restricted analysis to feathers from birds known to be adults. Thus, I can safely assume that the feather collected from adults was grown on the territory during the prebasic molt of the previous autumn. However, because first-year (SY) birds could have grown their rectrix in a different habitat type before dispersing to the site of capture (CRAMP 1992), their rectrices were omitted from the analysis.

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### Results

A total of 100 adult Graceful Warblers were sampled. Fifty nine were from territories in the reeds of the canal, and 41 from the salt marsh. The average total length of the rectrices from the two habitats, number of fault bars, wing chord length, and body mass were not significantly different (Table). However, the average of 10 growth bars of the birds from the reeds were significantly broader than those of the Eilat salt marsh.

Mean ( $\pm$ SD) of characteristics of the R5 rectrix (N=100) of Graceful Warblers living in the reed beds and the salt marsh in Eilat, Israel. Number in parentheses denote range of measurements.

Feather characteristic	Salt Marsh (N=41)	Reed bed (N=59)	Wilcoxon rank test (z; P)
Total tail feather	56.5 $\pm$ 6.1 (42.8-66.7)	57.2 $\pm$ 5.1 (43.2-66.0)	-0.59; 0.555
10-growth bars	22.5 $\pm$ 2.4 (15.7-27.2)	23.3 $\pm$ 1.9 (19.2-27.7)	-2.49; 0.013**
Fault bars	0.3 $\pm$ 0.9 (0.0- 5.0)	0.3 $\pm$ 0.7 ( 0.0- 3.0)	-0.66; 0.512
Wing chord (mm)	43.8 $\pm$ 1.3 (41.0-47.0)	44.4 $\pm$ 2.3 (40.0-56.0)	1.38; 0.167
Body mass (g)	6.4 $\pm$ 0.6 ( 5.1- 8.1)	6.4 $\pm$ 0.5 ( 4.1- 7.4)	-0.03; 0.975

Sex was determined only for the 23 males and 15 females caught in spring 1994. Males had significantly longer wing chord than females (44.7mm $\pm$ 1.4 SD, range 42-47 vs 43.6 $\pm$ 1.3, 41-46; Wilcoxon signed rank test z=-2.58, P=0.01) but not greater body mass (6.7 g $\pm$ 0.6, 5.7-8.1 vs 6.4 $\pm$ 0.4, 5.8-7.2; z=-1.6, P=0.11).

### Discussion

These results suggest that something about the salt marsh caused reduced nutritional condition of resident Graceful Warblers. However, at least one other explanation must be considered. The birds in the salt marsh could have been of low quality to begin with, perhaps having been habitat-imprinted while raised there, or having been excluded from better habitats by higher quality conspecifics. Thus, the poor feather growth in the salt marsh could have been a function of the individual bird rather than the habitat. We do know, however, that Graceful Warblers in the salt marsh were not unusually small because there was no difference in length of wing cord, body mass, or total rectrix length of the birds.

Assuming that the reduced rate of feather growth in the salt marsh was a function of habitat type rather than bird quality, it must be also taken into consideration that the salt marsh is now surrounded on all sides by agriculture, recreational areas, and an army fortification. This "island" habitat may not necessarily reflect its true capability as in the past when it covered an extensive area and the invertebrate and vertebrate populations could continually be renewed from the surrounding environment. In contrast, the canal is now extremely rich in organic material because of the partially treated sewage water, plus the effluents of the mariculture institute and algae-growing plant. These cause eutrophication of the canal area allowing insects (e.g. algae-eating flies) to breed in large numbers, providing a good food resource for insectivores such as the Graceful Warblers.

A comparison of the two habitats clearly shows that the reed beds are a superior resource to the birds than the salt marsh. However, the Municipality of Eilat plans to cover up this canal and to destroy the reed beds. In addition, they blame the reed beds for harboring mosquitoes, leading to eradication procedures (e.g. spraying pesticides, bulldozing, burning) which negatively affects reed growth. The implication of this is that in the very near future we may lose a major resource for staging avian migrants from Europe and Asia.

Thus, although from the conservation point of view saving the reed beds is the most logical conclusion, we also have to take into account the political and planning considerations and to try and save not only the insect-laden reed beds but also the remaining area of the Eilat salt marsh. Eilat, an important migratory bottleneck on the northern edge of the Sahara-Arabian desert belt (SAPRIEL 1968, SHIRIHAI & CHRISTIE 1992, YOSEF 1995), is critical for many avian migrant species because in spring it is reached after a flight of almost 2000 km across continuous desert regions of the Sahara and Sinai deserts. However, to the north-north-east there are still 650 km more of the Syrian Desert, and due East the vast Arabian desert. This magnifies the importance of preserving the only remaining habitats — the reed beds and the salt marsh — as alternative refueling areas so that birds that have just accomplished a crossing of over 2500 km across inhospitable regions of northern Africa can feed prior to continuing their journeys to their breeding grounds in Europe and Asia.

### Zusammenfassung

Salzsümpfe im Riftvalley Israels sind von Erschließung bedroht, insbesondere seit der Frieden mit Jordanien zu einem Boom für Investitionen und Entwicklungsplänen geführt hat. Diese Entwicklung betrifft auch Eilat, einen wichtigen „Flaschenhals“ für den Vogelzug am Nordrand des nordafrikanisch-arabischen Wüstengürtels. Das Gebiet hat für Zugvögel eine entscheidende Bedeutung nach einem Flug über fast 2000 km Wüste. Von einer Salzsumpffläche von 12 km<sup>2</sup> sind gerade noch 0,04 km<sup>2</sup> übrig geblieben. Die Salzsümpfe waren für mindestens 70 Zugvogelarten von essentieller Bedeutung als Rastplatz. Um die Rolle der Salzsümpfe und der Rohrbestände für Vögel zu dokumentieren, untersuchte ich einen dort lebenden Standvogel als „Bioindikator“. Im Vergleich zwischen verschiedenen Habitaten sollte die Untersuchung des Federwachstums eine Bewertung erlauben. Im Herbst 1993 und Frühjahr 1994 wurden 59 Streifenprinien aus Revieren in Rohrbeständen und 41 aus solchen in Salzsümpfen gefangen; zur Untersuchung wurde eine zentrale Steuerfeder verwendet. Im Mittel waren 10 Wachstumsstreifen der Vögel der Rohrbestände signifikant breiter als bei den Tünglingen der Salzsümpfe. Daraus ist zu schließen, daß die Rohrbestände für die Vögel ein günstigeres Habitat darstellten als die Salzsümpfe.

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