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CAPTIVE AND FREE LIVING EUROPEAN STARLINGS USE DIFFERENTLY THEIR SONG REPERTOIRE

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INTRODUCTION

Differential use of song types according to context appears to be a common feature in songbirds [e.g.: the Chestnut-sided Warbler *Dendroica pennsylvanica* (Lein, 1978), the Aquatic Warbler *Acrocephalus paludicola* (Cachpole & Leisler, 1989), the Cuban Grassquit *Tiaris canora* (Baptista, 1978)]. The song types used can differ according to the season [e.g. the South island Robin *Petroica australis* (Powlesland, 1983)], the bird position in the territory [e.g.: the Tufted Titmouse *Parus bicolor* (Schroeder & Wiley, 1983)], the intra — or inter — sexual context (e.g. the Red-winged Blackbird *Agelaius phoeniceus*, Searcy & Yasukawa, 1990).

On the basis of field recordings in different populations, Hausberger (1997) distinguishes three classes of songs in European starlings. Class I songs correspond to loud whistle types that are shared by the wild males of most populations (“species-specific themes”: e.g. Adret-Hausberger, 1989); class II songs correspond to whistles that characterize individual males within a nest colony in the field and include heterospecific mimics (“individual themes”: e.g. Adret-Hausberger *et al.*, 1990); class III songs are long continuous and complex songs (“warbling”: e.g. Adret-Hausberger & Jenkins, 1988). The class III songs are often preceded by class II songs (Eens *et al.*, 1989; Hausberger, 1991; Chaiken *et al.*, 1993).

Field observations have shown that male starlings use these song classes differentially according to pairing status (Henry *et al.*, 1994), colony size (Hausberger *et al.*, *subm.*) or social context (Adret-Hausberger, 1982). A differential use can even be observed within Class I songs according to season (Adret-Hausberger, 1984) or social context (Adret-Hausberger, 1982), particularly in song matching interactions. Only class I songs seem to be used in vocal interactions between males in field colonies. Each male starling has a repertoire of 3 to 5 class I songs and 1 to 12 class II songs (Adret-Hausberger, 1989).

Most field studies emphasize the frequent use of whistled songs by starlings in their colonies (Hartby, 1969; Feare, 1984; Wright & Cuthill, 1992; Motis, 1994) whereas little emphasis has been given to class I and II songs compared to class III

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songs by authors working mainly with captive birds (e.g. Böhner *et al.*, 1990; Eens *et al.*, 1991; Chaiken *et al.*, 1993). Hausberger *et al.* (1995) mention that their captive birds kept in outdoor aviaries produced few class I songs.

Little is known about the effect of captivity on repertoire use. Ball & Wingfield (1987) mentioned that captive and free-living birds differed in their testosterone levels. Therefore, differences in singing behaviour cannot be excluded.

In the present study we investigate this possibility by comparing the songs of captive males housed in an outdoor aviary, to those of free living males living in the same area. We compare here the frequency of emission of whistles and the use of class I and class II songs.

METHODS

STUDY SITE AND BIRDS RECORDED

Eight adult mated male starlings were observed in the same area near Bloomington, Indiana, USA. After looking at the feathers, we concluded that these 8 males were at least 2 years old (Feare, 1984). Four males (W1, W2, W3, W4) were observed in the field: two males (W1 and W3) that used nestboxes and one male (W2) that nested in a natural hole were in neighbouring trees (about 5 m apart), whereas the fourth male (W4) occupied a nestbox about 50 meters away. The males could be identified using their individual songs and nest visitations (see Adret-Hausberger *et al.*, 1990). The four captive males (C1, C2, C3, C4) had been wild caught as adults the year before near the field study area (10 km away) and were kept together in a 180 m² indoor-outdoor aviary (18 × 10 × 4 m) with 13 other individuals since October 1992, (4 adult females, 4 juvenile males and 5 juvenile females). Food (eggs, carrots, molasses, rice, wheat germs, dog food, pellets for chicken and turkey) and water were provided *ad libitum*.

All recordings were made at the beginning of the breeding season (nest building) when the males were already mated (April).

RECORDING CONDITIONS

The recordings were made morning: 6 to 12 hours of continuous observations were made for each free living bird and 27h30 in the aviary (Table I). A TCD 5 Sony cassette recorder or a Marantz cassette recorder and a MD Sennheiser microphone were used. Sonograms were made using an Amiga 3 000 microcomputer programmed for sound analysis (Richard, 1991).

We recorded the vocal interactions that occurred between birds. We considered that a vocal interaction occurred when a bird responded to an other bird with a song type similar to the first one; this vocal interaction was classified as song matching.

RESULTS

Classes of songs could clearly be differentiated. Five to twelve different whistle types were recorded for each male, no significative difference was found between groups (Mann Whitney test, $n_1 = 4$, $n_2 = 4$, $U = 4$, $p > 0.05$).

However, the wild birds produced more whistles in a given time period than the captive birds (Mann Whitney test, $n_1 = 4$, $n_2 = 4$, $U = 0$, $p = 0.014$).

Moreover, the wild birds produced 16 to 25 % of class I songs whereas the captive birds produced only 0 to 15 % of those songs ($n_1 = 4$, $n_2 = 4$, $U = 0$, $p = 0.014$). The captive birds produced almost only class II whistles (Table I).

TABLE I

Characteristics of songs produced by captive and wild starlings. Note that the captive males use few class I songs although they are able to sing them as shown by the vocal interaction involving C2 and a wild male ().*

	C1	C2	C3	C4	W1	W2	W3	W4
Total number of whistles recorded	28	12	169	64	152	85	87	121
Total recorded time (hours)		2 27h30			12	6	6	12
Mean number of whistles (\pm SD) per 6 hours of recording		15 \pm 13				77 \pm 10		
Number of different whistle types	6	5	12	10	9	13	8	12
Proportion of class II songs	100	100	85	98.5	76	84	83	75
Proportion of class I songs	0	0	15	1.5	24	16	17	25
Vocal interactions								
Number using class I songs			1*			13		
class II songs			19			0		

The difference is still more obvious concerning vocal interactions. All vocal interactions between wild birds involved class I songs, whereas 100 % of the vocal interactions between captive birds involved class II songs (Table I). One song matching interaction was observed between a captive and a wild male and it concerned class I song.

DISCUSSION

A comparison of the singing behaviour of captive and free living adult males clearly shows differences in their singing behaviour.

Free living birds produced more whistles and a higher proportion of class I songs than did captive males, who mainly produced class II songs. Captive males did have class I songs in their repertoire, since they produced them occasionally, but captivity did not seem to be an appropriate context.

These observations are in accordance with those of Hausberger *et al.* (1995) who observed that captive males produced few whistles and a low number of class I songs. Neither Böhner *et al.* (1990) nor Chaiken *et al.* (1993) mentioned a large number of whistles with their “captive indoor” birds.

It is interesting to note that on the contrary to wild yearling males (Adret-Hausberger *et al.*, 1990), young birds raised in the outdoor aviary never produced any class I songs as yearlings whereas they produced class II and III songs (Henry, in prep.) The young birds used the songs that adults used the most underlying the importance of social environment for song selection (see Nelson, 1992).

These results bring further evidence of a selective use of song repertoire by European starlings. Captivity, even under outdoor conditions, induces physiological differences in that free living birds always have higher plasma testosterone levels (Ball & Wingfield, 1987). The amount and the type of whistles produced seems to be related to hormonal levels (Adret-Hausberger, 1984). Therefore a physiological determinism may be involved.

In captivity, the social environment appears more stable than in the wild. In an aviary, the same individuals are always present in the same small area. Birds know each other well and interact all the time with the same individuals. On the contrary, in a natural situation, birds may interact with birds from different area with sometime a different dialect (Adret-Hausberger, 1982). In such a situation, birds produce the class I songs that are used in male-male interactions (Henry *et al.*, 1994) (see also the use of loud calls in male monkeys: Snowdon *et al.*, 1983).

This study raises the problem of studying song in captivity and emphasizes the importance of field description bases before interpreting results obtained under captive conditions, even under naturalistic conditions (see also Kroodsma, 1982; Payne & Payne, 1997; Zann, 1997).

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SUMMARY

Differential use of song types according to context appears to be a common feature in songbirds. However, little is known about the effect that captivity can have on repertoire use. Vocal behaviour of 4 wild and 4 captive American male starlings observed during the same period was compared. Results showed that the quality and the quantity of song produced differed between the 2 situations. It appeared clearly that social environment plays a deciding role in the use of song in starlings. These results also indicate that birds do not necessarily produce the totality of their "repertoire" in different social contexts.

RÉSUMÉ

L'utilisation de différents types de chant en fonction du contexte semble un fait commun chez les oiseaux chanteurs. Cependant, nous possédons peu d'infor-

mations concernant l'effet de la captivité sur l'utilisation du répertoire. Nous avons observé et comparé le comportement vocal de quatre Etourneaux sansonnets américains sauvages et de quatre Etourneaux sansonnets américains captifs pendant la même période de l'année. Les résultats montrent que la qualité et la quantité de chant produit diffèrent dans les deux situations. L'environnement social joue un rôle déterminant dans l'utilisation du chant chez l'étourneau. Nos résultats montrent également que les oiseaux ne produisent pas nécessairement la totalité de leur « répertoire » de chant dans différents contextes sociaux.

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