DIFFERENCES BETWEEN THE SOCIAL BEHAVIOUR OF TWO SPECIES OF MACAWS OF THE GENUS *ARA* (AVES, PSITTACIDAE) IN CAPTIVITY

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The statistical analysis of the social relationships established in a mixed group of Macaws *Ara macao* and *Ara ararauna* in captivity, allows to order the individuals using an index of social integration. The discriminative analysis of the social interactions, separates the individuals in two groups specifically differenciated.

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INTRODUCTION

The species or the genus *Ara* are social birds which in the wild live in flocks of 40 to 50 individuals composed by family groups of two to four animals (FORSHAW, 1973). They form pairs, and this social structure is kept when big flocks of hundreds of individuals are constituted (HAVERSCHMIDT, 1954).

The distributions in the wild of *Ara macao* and *Ara ararauna,* overlap to a large extent, living both species in the south american area between the Andes and the Atlantic coast and from the Caribean to the North of Argentina.

There is one difference concerning to the habitats that each one of the species prefers, *A. macao* is mainly found in open woodland and tropical savannah (MONROE, 1968; MEYER DE SCHAUENSEE, 1964; PHELPS & PHELPS, 1958) and less often in rainy forest. *A. Ararauna* lives preferably in forest and palm trees which grow by rivers and marshes (DUGAND, 1947; STAGER, 1961; YOUNG, 1929; SNYDER, 1966; in litt. to KING, 1976). During the rainy season the latter might leave the dense forest and travel long distances to feed in secondary forest, specially when the jabillo trees *Hura crepitans* has ripen.

However, the fact that both species live in areas that overlap means that they do found themselves in the same habitats. These mixed population have been reported in Surinam by HAVERSCHMIDT (1968). DUGAND (op. cit., 1947) observed the species *A. macao* on jabillo trees *Hura crepitans* which were also visited by *A. ararauna* during the day, in open spaces and during the rippening of these fruits.

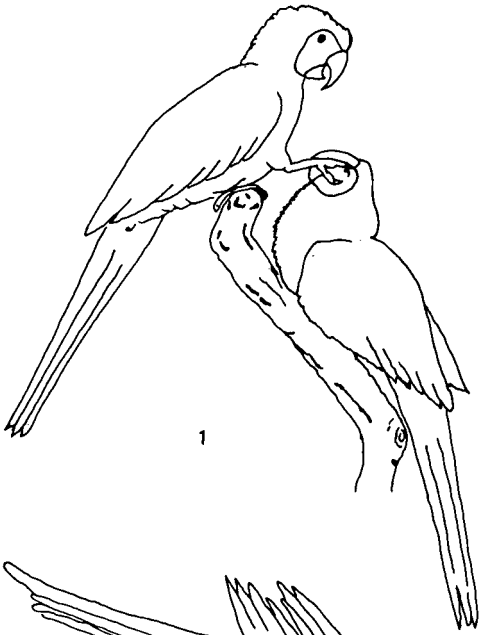
From all this, it can be said that the study of the social relationships of a mixed flock composed by four individuals of *A. macao* and six of *A. ararauna* kept in captivity, is a rational group since these two species in the wild, interact while feeding and resting which mainly constitute the acivities of these animals in captivity.

The agonistic interactions described by HARDY (1965) in groups of *Aratinga canicularis* in the wild and by BALPH (1980) in other species imply a social order within the flock which with the friendly interactions maintain the pair bond all through the year.

These facts can be used to interpretate the biologica importance of the interactions between the individuals that are kept together in captivity forming a social group.

MATERIAL AND METHODS

Data were collected from six individuals of



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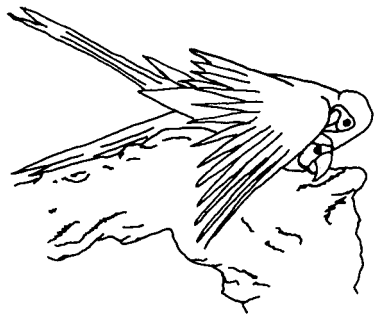

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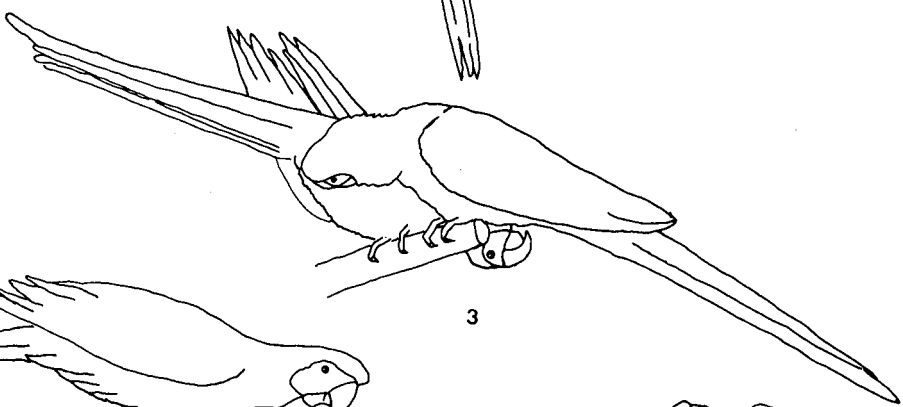

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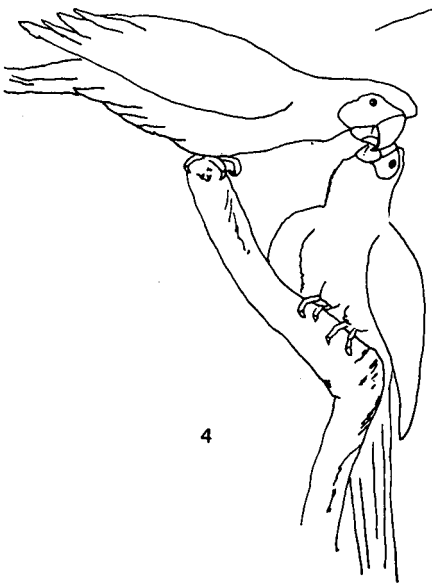

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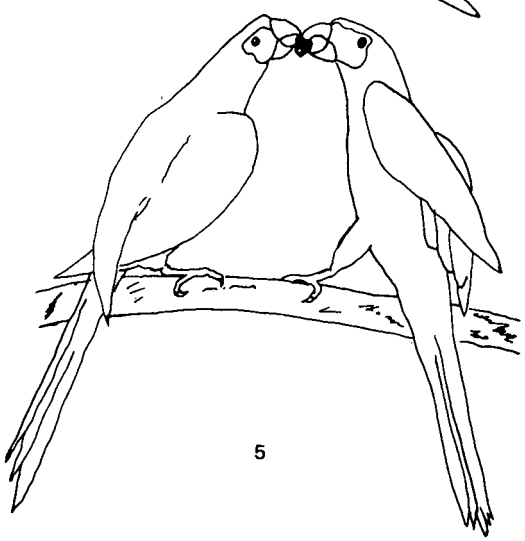

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A. ararauna (A_1, A_2, A_3, A_4, A_5, A_6) and four of *A. macao* (M_1, M_2, M_3, M_4) which were kept together in a cage measuring 7 X 5 X 5 m in the Aviary of the Zoological Park of Barcelona (Spain). All the specimens were adults and had been taken to the Aviary on 1973. 50 hours of observations were made during October and November 1978 (5 per each animal) and as a result more than 4.000 behaviours were registered.

The behaviour patterns that have been registered are all social with the exception of the Autogrooming which even if it only involves one individual it plays an important role in connection with the social patterns. Autogrooming inhibits aggression and elicits friendly interactions (CAMERINO et al., 1979). The behaviour patterns quantified in this study wich have been described by URIBE (in press) are: Staring, Application of the beak, wing or the claw (fig. 1 and 2), Wheelallopreening (fig. 3), Throwing the beak, Crossing of beaks (fig. 4), Display of open beak or claw, Mutual pinching of beaks, Pecking, Taking food from the beak of another (fig. 5), Flight and pecking, Approximation, Approaching the beak, Allopreening, Autopreening with claw, Autopreening with beak, Supplanting locomotion.

The registered date has been analyzed with two statistical tests.

1. The Social index of Mobility defined by HARDY (1965): $I_{mi} = n_i \ F_{ij}$.

In this paper a transformation of the I_m is also used and has been called Morphological index of Sociability (I_s): $I_{si} = R_i \ N_{ij} \ F_{ij}$.

Being I_{mi} the Social index of Mobility for the individual i; n_i the number of individuals with which i has interacted; F_{ij} the frequency of the behaviours j displayed by i; I_{si} the Morphological index of Sociability shown by i and R_1 the number of behaviour patterns displayed by i.

2. Discriminatory analysis of the two subpopulations both composed by homospecific individuals. URIBE (in press) finds significative differences when using the t Student test for the mean frequencies of each behaviour shown by both species.

For the statistical calculations, the social patterns have been quantified under two aspects: active and pasive; this allows to calculate for each individual the frequencies of each behaviour that is given or received to or from another individual. The statistical analysis has been carried out at the Centre de Càlcul de la Universitat Autònoma de Barcelona, using a Digital VAX/VMS computer.

RESULTS

1. Social index of Mobility and Morphological index of Sociability.

Table 1 shows the absolute frequencies of the activie patterns for all individuals, without taking into account both types of autogrooming. This table also displays the number of individuals with which each animal of the flock interacts.

The numerical order of the Sociability index gives the ordering of the individuals in relation to their degree of social mobility and to the diversity of the behaviours displayed.

After analyzing the histogram (fig. 6), it can be seen that *A. ararauna* individuals are more integrated than *A. macao.*

Figs. 1-5: 1. Application of the claw. The addressor puts an open claw on the addressee's head. 2. Application of the wing. The addressor puts one wing over the addressee's body and on occassion covers it completely. 3. Wheelallopreening. The bodies of both birds are parallel and they are looking in opposite directions. They are simultaneously allogroming one another's anal region, so that one has the head lifted and the tail lowered and the other the head lifted and the head lowered. 4. Crossing. The addressor, from a higher position, holds with the beak the top part of the addressee's. In this position displays a quick succession of vertical movements. 5. Food steal. One animal takes or tries to take the food that another one is holding with the beak.

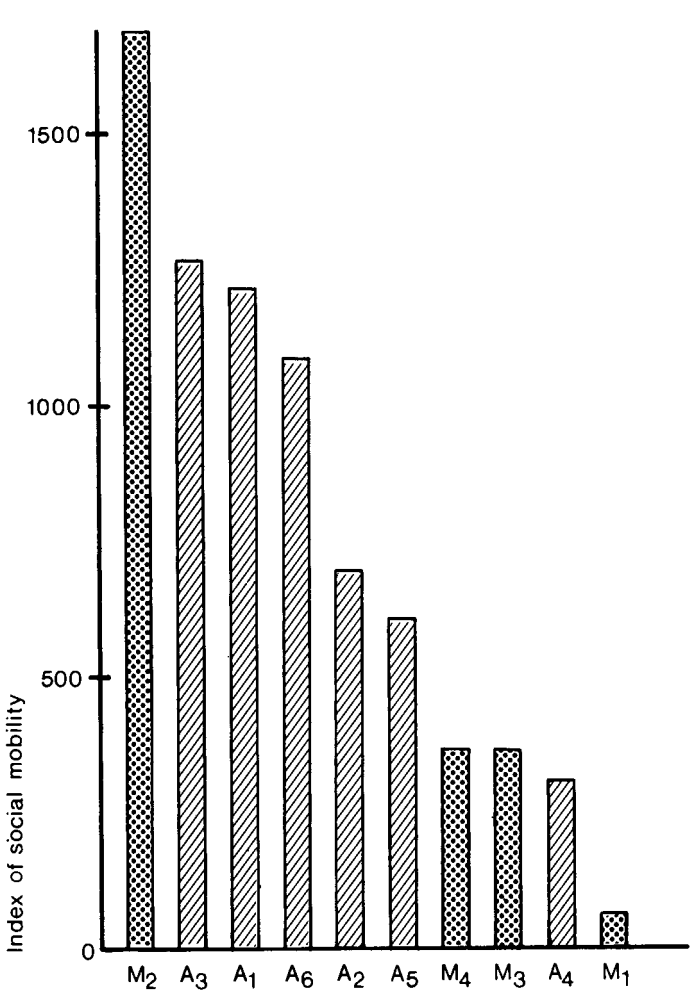

Fig. 6. Histogram of the social index of Mobility shown by the macaws of the species *A. macao* and *A. ararauna.*

Table 1. Hardy's social index of Mobility and Morphological index of sociability of all the individuals of the mixed flock of *A. macao* and *A. ararauna.*

Individuals	Number of interactions	Number of individuals with whom interacts	Number of behavior patterns displayed	Hardy's index of social Mobility	Rank of each individual's index of mobility	Index Morphological of sociability	Rank of each individual's index of social diversity
M_1	11	7	3	77	10	231	10
M_2	282	6	12	1.692	1	20.304	1
M_3	62	6	9	372	8	3.304	8
M_4	54	7	9	378	7	3.402	7
A_1	153	8	14	1.224	3	17.136	2
A_2	101	7	11	707	5	7.777	5
A_3	142	9	13	1.278	2	16.614	3
A_4	105	3	10	315	9	3.150	9
A_5	88	7	9	616	6	5.544	6
A_6	182	6	10	1.092	4	10.920	4

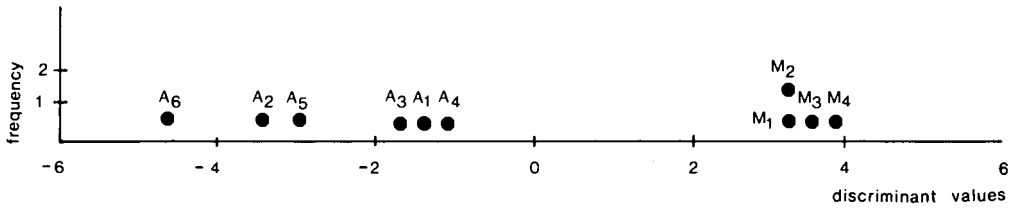

Fig. 7. Discriminatory values for all the individuals.

Table 2. Values of the standarized coeficient in the canonical Discriminatory function of the behaviours that have reached tolerance values greater than 0,001. They are placed in descending order and the sign shows to which species it discriminates: *A. macao* (+), *A. ararauna* (–).

Staring (pasive)	3,18	Application of the wing (active)	1,77
Crossing of beaks	2,78	Throwing the beak (active)	– 1,75
Wheel-allopreening	– 2,01	Staring (active)	1,37
Application of the wing (pasive)	– 1,89	Throwing the beak (pasive)	– 0,70

Within the *A. araurana* there are two levels of integration: on the first one there are the very integrated macaws (A_3, A_1 and A_6) which are also the most active ones; on the second one, those less integrated (A_2 and A_5), less active and that interact with less individuals. *A. ararauna* A_4, is the least socially integrated animal of the whole flock, mainly because it interacts with very few other animals.

Within the *A. macao* the exception is M_2 which is the macaw with the highest level of social integration. It is a very active individual (number of encounters: 1282).

Since the number of interactions and the number of behaviour patterns are correlated, the Morphological index of Sociability shows a very similar ordering to the one of the Social index of Mobility (except A_1 and A_3).

2. Discriminatory analysis.

The Discriminatory analysis has shown to be very effective, giving a high canonical correlation of the discriminatory function (0,954) and a very low Wilk's Lambda (0,090).

The analysis also creates groups of prediction which coincide 100% with the original ones, that is to say that the individuals, as far as their social behaviour is concerned, can be clasified in two discrete groups which coincide with the two species (Fig. 7).

Table 2 shows the contribution in the discriminatory function of the variables that reach values of tolerance of more than 0,001. From these results it can be said that Staring and Crossing of beaks characteristic of individuals of the species *A. macao* while Wheel-allopreening is typical of *A. ararauna.*

When looking at the frequencies of behaviours in both *A. macao* and *A. araurana,* the Discriminatory analysis confirms that the social patterns of both species are clearly different.

DISCUSSION

HARDY (1965) states that the interactions or social encounters between members of a flock should be understood, in broad sense, as the sum of agonistic and friendly encounters, and defines the Social index of Mobility as the measure of Mobility of an individual or the degree of interaction or sociability.

The factor "number of behaviour patterns", reasserts the meaning of sociability, in the sense that the individuals with higher index values are the ones with greater diversity of patterns.

The greater sociability of *A. ararauna* can be seen when both index values are in descending order.

In Hardy's results (op. cit. 1965) with a flock of 14 individuals of *Aratinga canicularis* it can also be observed that the number of individuals with whom they interact hardly varies between them. *A. canieularis* interacts with more individuals than the macaws which could be due to the fact that the friendly interactions between different species should be substracted from the total value (Since they do not normally occur).

The results obtained from A_2, which are completely atypical could be due to the fact that this individual had been hand reared and showed a very high sociability. This was made obvious by its very short tail as an efect of its continuous rubbing while moving. In contrast to this, less active individuals which were also more isolated had their tails in much better conditions.

The results of the Discriminative analysis, agree with Uribe's results (in press) in that *A. macao* displays more aggressive behaviours and less friendly or contact patterns.

These behavioural differences between both species, which are found in the same ecological niche, could be explained as a differentiation caused by the selective pression to avoid hibridation.

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