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NESTING BEHAVIOUR OF DALMATIAN PELICAN (*Pelecanus crispus*, BRUCH 1832)

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ABSTRACT. The research was conducted over a period of four years from 1995 to 1990 (over 930 hours) on 4.39 ha ponds at Poznań Zoo (Poland). Both sexes are equally prone to initiate creation of a pair bond. There are two kinds of pair binding behaviour: much more frequent one by "inflating pouch", that is not directed towards any specific bird and second, directed on a concrete bird, by accompanying, and greeting the chosen partner. There are two kinds of greetings. First by "showing pouch" presented by both partners at the same time, and second by "raising bill" presented by bird not currently incubating. Nest placement is chosen by a female. Pairs try to occupy better (higher) place. Both sexes build nest, but male usually collects nest-material. Majority of copulation occurs 7-4 days before lying the first egg. Both partners incubate eggs.

KEY WORDS: breeding behaviour, pair bonding, greeting, copulation, Zoo

INTRODUCTION

Due to extreme shyness and sensitivity to disturbance Dalmatian pelican (*Pelecanus crispus*) is prone to abandon the colony when unnecessarily stressed (CRAMP and SIMMONS 1977, STEINBACHER 1968, DEL HOYO et al. 1992). Therefore it is very difficult to conduct behavioural research in its natural habitat. This is a

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reason that most behavioural data were collected sporadically during researches concentrating on other aspects of biology of this species.

The nesting behaviour of Dalmatian pelican is rather little known and especially our knowledge on ethological mechanisms is very limited. We believe that one of possibilities to broaden our knowledge on the behaviour of Dalmatian pelican is through observation in captivity. In spite of all limitations, it may reflect natural behaviour quite closely, especially because the same, recognisable individuals are a subject of observation throughout the years.

The aim of this paper is to show the general mechanism of nesting behaviour rather than all aspects of reproductive biology of Dalmatian pelican.

MATERIAL AND METHODS

The observations were conducted from 1995 till 1999 during the breeding season (over 930 hours).

Dalmatian pelicans in Poznań Zoo share the same exhibit with eastern white pelicans (*Pelecanus onocrotalus*), maintained also as a breeding colony. On average there were 5 males and 6 females of Dalmatian pelican, but the sex ratio varied through the years. Pelicans are kept on a pond of 4.39 ha. There are two islands, but only one, overgrown with holy (*Sambucus nigra*) and different willow species (*Salix* sp.) is used for nesting.

Observations were made from south eastern bank of the pond, by binocular 20/50.

RESULTS

Formation of breeding pairs

Dalmatian pelicans begin to breed almost immediately after release from winter quarters. In our case this is usually around middle of April. There is no apparent sex domination and both sexes are equally prone to initiate creation of a pair bond.

Two mechanisms of pair binding behaviour may be observed among Dalmatian pelicans.

First of them is much more frequent use of "inflating pouch" behaviour. Unpaired individuals, or birds with a partner not ready to breed yet (in this case there

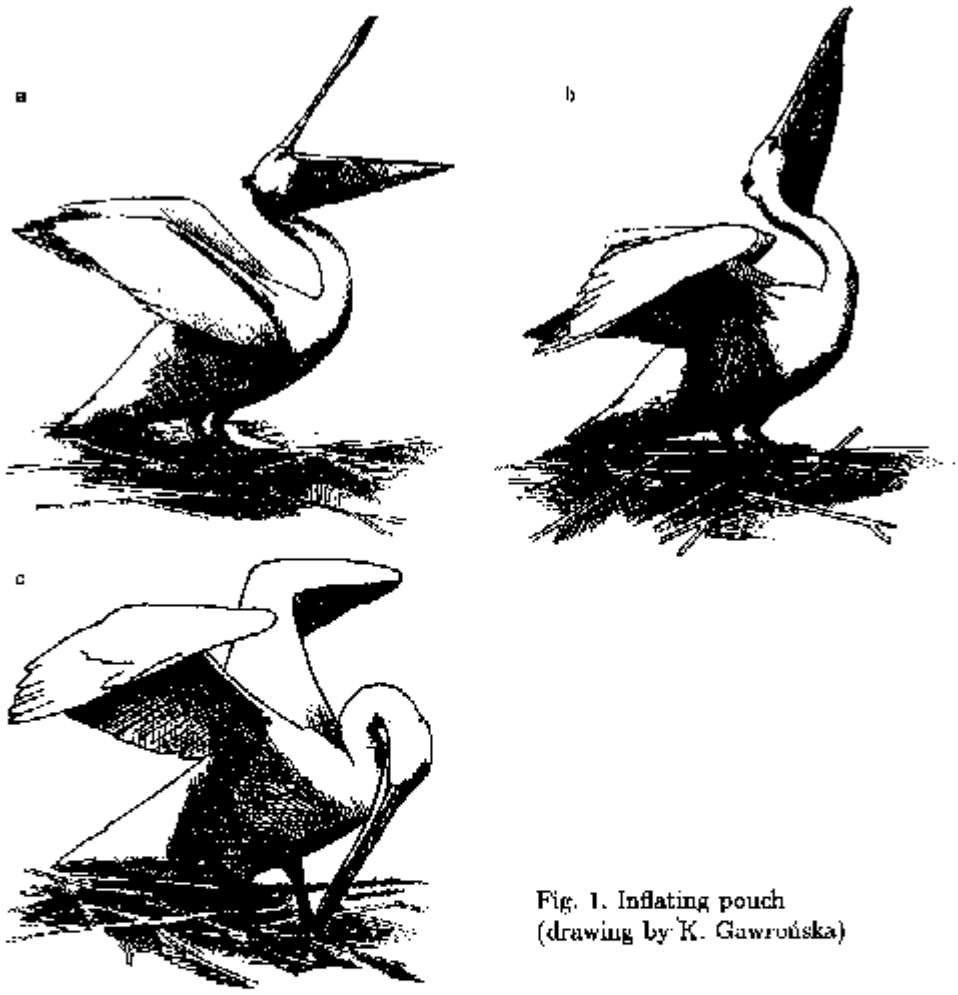

Fig. 1. Inflating pouch
(drawing by K. Gawrońska)

is a possibility to change partner) raise their bill up, open pouch widely, quickly closing gular pouch what results in inflating it with air, press bill towards its body Then they slowly release air from the pouch (Fig. 1a, 1b, 1c). These actions usually last 2-4 seconds and are repeated a few times ($\bar{x} = 3.8$ sec., Sd = 2.61 sec. and repeat $\bar{x} = 3$ times, Sd = 2.44 for n = 21 inflating pouch of males and $\bar{x} = 1.91$, Sd = 0.89 sec., repeat $\bar{x} = 1.31$ times, Sd = 0.66 for n = 38 female's inflating pouch). This behaviour is not directed towards any given individual and is rather a "matrimonial offer". If there is any bird in colony ready to nest, it immediately runs towards the performer and greets the other with open wings raising its bill up and down several times (Fig. 2) or by showing pouch (Fig. 3). If a bird performing "inflating pouch" behaviour already has a partner, it performs this activity in the absence of a regular partner or if it is distanced farther than ca. 10 meters. Both male and female display this behaviour.

Fig. 2. Greeting by raising bill (drawing by K. Gawrońska)

Second way of creating pairs is directed towards a concrete individual. In this way an individual stays close to the chosen bird. If a chosen partner is attacked, or will display aggressive behaviour towards other pelicans the other member of the pair helps him and regularly greets by raising bill, and showing pouch. This process lasts for a long time, even a few days, if it is effective at all. A pair was formed in this way by just sexually matured, three year old birds. Of course these behaviours are present in permanent pairs too.

Birds released from winter quarters are not showing pair bonds. During subsequent clutches of the year birds usually stay with the same partner, but there are some instances of changing partners on next nesting attempt.

We can observe that if a pair bred together for several times, or seasons it is more difficult for a bird to change partner.

Fig. 3. Greeting by showing pouch (drawing by K. Gawrońska)

In Dalmatian pelicans there are few behaviour patterns to strengthen pair bond. There are two kinds of greeting. First is shown by birds when one member of a pair is not on the nest. During this greeting it stands usually with open wings and rhythmically raises its bill up high and down (Fig. 2) in the direction of a partner. This behaviour takes about 5 seconds ($\bar{x} = 4.97$, $Sd = 4.78$, $n = 325$ for males and $\bar{x} = 5.23$, $Sd = 7.04$, $n = 451$ for females).

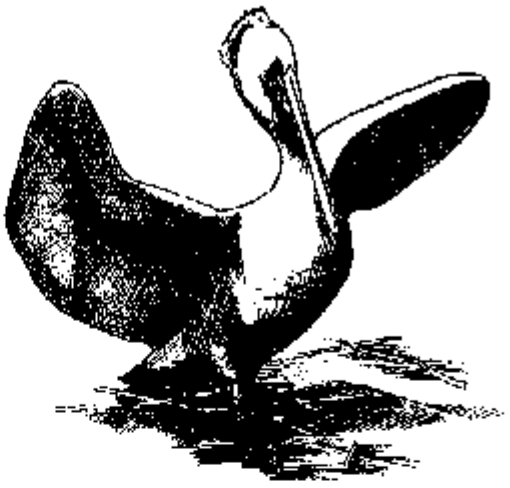

Fig. 4. Running (drawing by K. Gawrońska)

This behaviour is presented usually after agonistic behaviour (aggression or defence), after returning to the nest. It can be induced by rolling eggs by partner or by this kind of greeting by other pairs. This behaviour can be further strengthened by "running", observed usually before laying first eggs of a given pair. Bird runs with slightly open wings (Fig. 4) towards water, then turns back and quickly runs to the nest to greet partner. This behaviour can be repeated for a many times and takes over an hour. In two cases which where fully observed it took 74 and 104 minutes.

Second kind of greeting is performed together with partner, from time to time simultaneously with other pairs. Partners show sides of their pouch and black spot to one another (Fig. 3). Before nesting, when performing this behaviour, pelicans additionally lower their heads. This action usually lasts for about 4 seconds ($\bar{x} = 3.68$, $Sd = 1.98$, $n = 230$ for males and $\bar{x} = 3.85$, $Sd = 1.81$, $n = 196$ for females) and may be performed during any activity in the colony.

Additional agonistic behaviour presented by both partners to another pairs plays a very important role in pair binding.

Choosing nest and colony location

Only sexually active birds participate in choosing place for establishing a colony.

At Poznań Zoo the Dalmatian pelicans built colony together with eastern white pelicans and the choice of colony location probably is made in accordance with both species preferences.

During searching for place for establishing a colony, birds are very nervous and aggressive towards other pelicans as well as other species (for instance they

destroyed a nest of Canada goose (*Branta canadensis*) and are very mobile. During this time pelicans run around the whole island visiting usually less frequented parts, even such that are unsuitable for building nest. From time to time they stay longer in one place and try to begin with nest building. Because pelicans examine a number of interesting places, the choice is made by a single, most motivated female, that starts to build nest there. Other individuals frequent this location more and more often and this finally results in establishment of a colony. There is a strong competition for the best (the highest) placement of a nest in the colony

A female usually chooses nest location. Female stays in a chosen place, performing at the same time a bowing behaviour (Fig. 1c). This kind of behaviour closely resembles position attained during rolling of eggs.

All breeding pairs use the same general location within colony, but in 1998 and 1999 just matured birds, breeding for the first time, initially tried to occupy place of an old, abandoned colony.

Since 1984 till 1997 pelicans choose as a location of colony the same place, in the 1998 after dying of surrounding holy, pelicans abandoned this place and choose another place of about the same characteristic. It was a platform of branches 30-70 cm high, protected in part by surrounding holy and at least on one side with open access to water. In 1999 pelicans again changed placement of colony, but to site more protected by bushes. In 1999 pelicans started building their nests straight on the ground.

Nest building

Pelicans begin with nest building immediately after releasing them from winter quarters. The most intensive nest building is performed down to egg lying. During that time frequent mating is observed.

Dalmatian pelicans usually choose sticks with diameter $\bar{x} = 0.91$ cm, Sd = 0.6 cm and length $\bar{x} = 50.9$ cm, Sd = 31.5 (n = 143 sticks) as a building material. Material is collected straight from the nest, all over the island, pulled from water or even from reed beds surrounding the pond. Both birds collect material for the nest. In the 1997 male from one pair took material ten times more frequently than female, but a male from another pair was less active and took material only twice more frequently than female. Female takes collected material straight from male's bill. During intensive building, nest grows up to a height of about 50 cm over platform and reach as a diameter of 40 cm. During breeding season by continuous building and repairing, nest is not getting higher but the diameter increases to 60-70 cm. The mean distance between nests was 80 cm (3 events). This distance decreases in the course of breeding season. At the end of the season individual nests grow together into one heap. After loosing eggs pair usually occupy the same nest for the next clutch.

Mating behaviour

As it was already mentioned, mating is concentrated during intensive nest building (7-4 days before laying first egg). The gestures performed by female during nest building are similar to ones meaning readiness to mate. That may result in provocation of males to mate. Female willing to be mated lays with protruding neck and tip of the bill directed towards thorax. Usually she is lowering wings a little (Fig. 5). Because this position is presented much more often then necessary to repair the nest (that sometimes even does not exist yet) it is suspected that this kind of behaviour acts as a manifestation of readiness to mate.

Fig. 5. Provocation to mate display (drawing by K. Gawrońska)

Copulation usually takes place o the nest. In breeding pairs no copul tion outside the nest was recorded. female does not have a partner and doe not occupy any nest she may be mate in other places as well.

During normal mating female lie down and male catches female's neck, c head by his bill. The male then climt on female's back. In this moment femal raises her tail and expose cloaca. The male lowers his tail and few times rut cloaca. During copulation male balanc by waging with his opened wings (Fi 6). The copulation takes $\bar{x} = 10.59$ s conds (Sd = 5.37, n = 17). Among ob served copulation 73% (n = 98) can b considered as successful. Main reasor of unsuccessful copulation are: aggre sion of another pelicans; troubles wit balance and wrong angle of a male to female.

Fig. 6. Copulation (drawing by K. Gawrońska)

Incubation period

Full clutch consists of 2 eggs. The second egg is usually laid after one day interval. Only homosexual (female) pairs lay clutches larger than two eggs.

Both parents share the incubation. In two closely observed pairs females incubated for 67% of total time. Changes on the nest average one a day, usually before midday, after morning hunting. After choosing nest to lay egg of first clutch, nests were occupies nearly only by female. Few days before egg lying of second clutch very often changes on the nest were observed. It might even take place even every few minutes.

Most often relief bird pushes the incubating one out and attains a position similar to rolling eggs (Fig. 1c). This position is presented by incubating bird after return of a partner to the nest or after strong fighting, even if nest is still empty. After "bowing", incubating bird usually repairs the nest.

Non-incubating bird usually stays near nest, or colony. It is important for helping in fights between neighbouring pairs. Sometimes, a bird leaves the nest without any prior warning, and the other partners comes to replace it. This pattern is not considered normal.

Abandonment of nest for any period of time results in immediate stealing of nest material by other pelicans and used to build their own nests. Eggs can roll out by themselves or be thrown away by other pelicans (it was observed that Eastern white pelican threw out eggs of Dalmatian ones). From all eggs incubated by Dalmatian pelicans during 1997-1999 – 27% (n = 30) were rolled out of nests.

When birds incubate eggs they probably cover them with their feet. At first they lie down and then put their feet on eggs.

Clutch is incubated from first egg, so chicks hatch asynchronously.

DISCUSSION

In the wild birds choose for colony places were reed beds were earlier trampled during roosting (CRIVELLI 1987). This places are still protected by surrounding reed beds (CRIVELLI and MITCHEV 1997, CRIVELLI et al. 1998, DEL HOYO et al. 1992, DOLGUSHIN 1960, ROMANOW 1987). Like in our situation they are open to water (STEINBACHER 1968). In a zoo situation the possibilities of choosing colony location are somehow limited and the choice must be compromised by existing facilities.

Because pelicans do not lay eggs synchronously in the wild, then they create units with similar timing of egg lying (CRIVELLI 1987, CRIVELLI et al. 1998, DEL HOYO et al. 1992). Small number of birds can cause absence of this behaviour,

because pelicans need social stimulation to breed (BROUWER et al. 1994, CRIVELLI 1987).

According to HEDIGER (1965) pelicans in captivity form pairs in winter quarters. DOLGUSHIN (1960) found in Kazakhstan, that birds are coming from winter grounds in mated pairs and immediately start to breed Similar observations was made by CRIVELLI (pers. com.). On contrary, our pelicans do not show any pair binding in winter quarters. The pair binding occurs immediately after release from winter quarters.

DEL HOYO et al. (1992) mentions that the actual pair binding may take as short as four hours, but he does not provide any details of this process and he treats "pouch swollen up like balloon" as one of territorial behaviour patterns. Additionally he does not mention which species of pelican he deals with. In this paper "inflating pouch" is treated as "matrimonial offer" leading to quickly forming pairs and it can takes even only few minutes. VAN TETS (1965) provided the detailed description of inflating pouch, but the author does not describe function of this behaviour.

One of methods of pair-binding behaviour, as described by DEMENTIEV and GLADKOV (1951) and DOLGUSHIN (1960). Is that a female sits on the nest and male moves around female and then he runs to the water and back to the nest. It is difficult to evaluate this behaviour, especially because there is no detailed description, or a picture of this display, but it seems very similar to "greeting by raising bill" and "running" as described earlier. This role of this kind of behaviour is to strengthen bond between newly formed pair.

On contrary to Poznań Zoo, where birds are rather conservative in pairing, DEL HOYO et al. (1992) ascertain that there is no data suggesting that pairs are stable and they may swap partners even for successive clutches in one breeding season. CRIVELLI (pers. com.) found that in the wild Dalmatian pelicans never repeat breeding with the same partner. This is difficult to interpret, because in captivity birds are kept together throughout the years, repeated pairing with the same partner is therefore forced to some degree, as there is no free, unlimited choice.

Greeting by showing side of the pouch was observed in Dalmatian pelicans by CRAMP and SIMMONS (1977) after MEISCHNER (1959,1961) who treat this beha viour as threatening gesture. VAN TETS (1965) found this gesture as recognising behaviour, directed towards not only the mate, but also to neighbouring pairs. The aim of this display is to increase tolerance of nest mates but also their neighbours. This interpretation agrees with our observations.

In captivity Dalmatian pelicans build nests from any available material, but it is recommended to provide straw (BROUWER et al. 1994, GRUMMT 1984) what induces birds to build nests and initiate copulation behaviour. Availability of nesting material seems to have a direct influence on the copulation activity and supports a theory that nest building and copulation are related behavioural patterns.

The copulation usually takes place on the nest, more seldom outside of it, but there were no observation of a copulation on the water, what was observed in the

wild (DEL HOYO et al. 1992). Similarly CRIVELLI (pers. com.) found copulation to take place usually on the ground, more seldom on the nest.

DEMENTIEV and CLADKOV (1951) described that male is incubating eggs in morning and evening when the female is hunting. This doesn't agree with our observation. In Poznań Zoo usually a change of incubating bird takes place only once a day.

Under zoo conditions a certain (rather high in some instances) number of eggs is lost in incubation due to crushing, rolling out of nest, or other events. This is however not different to the wild where according to CRIVELLI (1987) 18-24% of all eggs are lost before hatching. The losses may be as high as 36-68% in some colonies as observed by CRIVELLI et al. (1998) in Amvrakikos gulf in Greece.

Rolling eggs out of the nest as suggested by SCHREIBER (1979) as typical for species incubating eggs by feet. Observation in Poznań Zoo suggest that reason of egg looses is often sudden departure form the nest, when a bird does not wait for partner. If one egg disappears from the nest the second one always disappears after a few days.

CONCLUSION

1. Both sexes are equally prone to initiate creation of a pair bond.

2. Major kind of pair binding is the "inflating pouch" display, and it can take even only a few minutes.

3. Provocative position to mate presented by female is probably similar to position during building of the nest.

4. Female usually selects the place for a nest. Colony grows around one nest of the most motivated female.

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