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Behavioral Development in the Red-Crowned Crane (*Grus japonensis*)

Robert H. Horwich

Institute of Micro-ontogenetic Ethology and Macro-cosmological Ecology, Gays Mills, Wisconsin

A male and a female red-crowned crane were observed on a weekly basis from hatching until 7 months of age. The levels for 12 classes of activity were averaged and displayed. Weekly weights and weight gains were also displayed. Developmental profiles are discussed. These include 1) cyclic profiles, 2) single developmental peaks, and 3) behaviors with a high initial level reducing to a later low level. The chicks seemed to display alternating passive and active periods. The cyclic nature of development is discussed in relation to similar cycles in other species of birds and mammals.

Key words: ethology, ontogeny, *Gruidae*

INTRODUCTION

The recurrence of behavior performance peaks (cycles) during development has been documented in a variety of mammals [Horwich, 1974a,b; Horwich and Manski, 1975; Horwich et al, 1977, 1982; Horwich and Wurman, 1978]. Even human behavior exhibits similar temporal peaks [Horwich, 1983]. Although many studies still commonly perceive behavioral development as a linear progression from infancy to adulthood, behaviors often develop in a cyclic manner, which may be superimposed on a linear trend [Horwich, 1974a]. Cyclic behavioral development has been observed in nature as well as captivity [Horwich and Gebhard, 1986; Clarke, 1982]. It serves a wide variety of functions, often species specific, such as maintaining group structure during periods of stress or change [Horwich and Manski, 1975; Horwich et al, 1977]. These cycles of sociality in the infant often grade into a social seasonality in adults [Horwich, 1972; Horwich et al, 1982]. Seasonal flocking in birds during migration suggested that birds might also show developmental cycling. Indeed, cycling is evident in the sandhill crane (*Grus canadensis*) [Voss, 1979] (Horwich, unpublished data) and has recently been used experimentally in reintroducing crane chicks into the wild [Horwich, 1985, 1986]. In the golden eagle (*Aquila chrysaetos*) the cyclic phenomenon has been explicitly shown in a wide variety of behaviors [Ellis, 1979]. The present study explored the behavioral cycling in red-crowned cranes.

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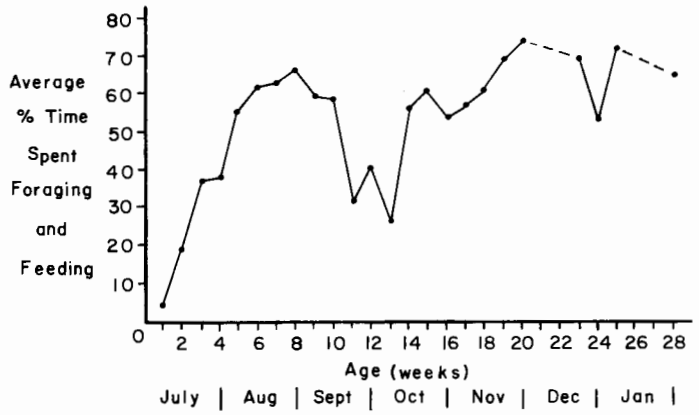
Address reprint requests to Dr. Robert H. Horwich, Institute of Micro-ontogenetic Ethology and Macro-cosmological Ecology, RD 1, Box 96, Gays Mills, WI 54631.



Figs. 1–12. Dotted lines indicate missed weekly observations. Fig. 1. The average percentage of time of two red-crowned crane chicks spent foraging and feeding as function of age in weeks.

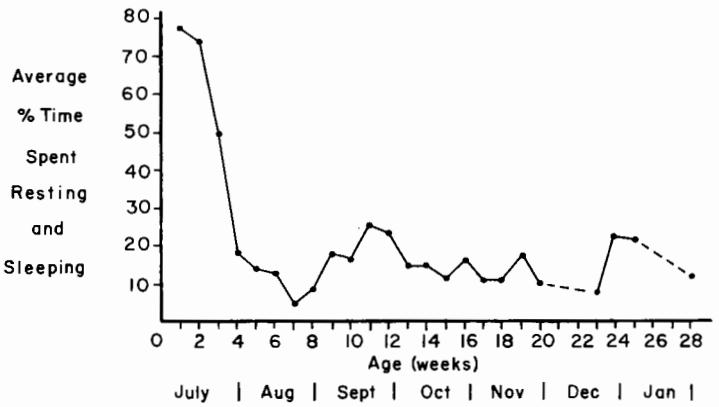


Fig. 2. The average percentage of time spent resting and sleeping as a function of age in weeks.

MATERIALS AND METHODS

Subjects

Two red-crowned cranes (*Grus japonensis*) were observed at the International Crane Foundation on a weekly basis from hatching until 7 months of age (July 1984 to January 1985). Frequency of performance was documented for the following activities: resting, sleeping, preening, foraging, feeding, drinking, calling, walking, shaking, wing-flapping, yawning, pacing, wing-leg stretching, head scratching, two-wing stretching, and agonistic interactions. Weight was also measured at regular intervals.

Apparatus

The chicks were initially observed in individual cages 1.8 × 3 × 2.4 m through one-way mirrors in isolation from humans for the first 9 (Harbin) and 4 (Jinlin) days. After that time, they were observed out of isolation in a small cage 0.8 × 0.8 × 0.5

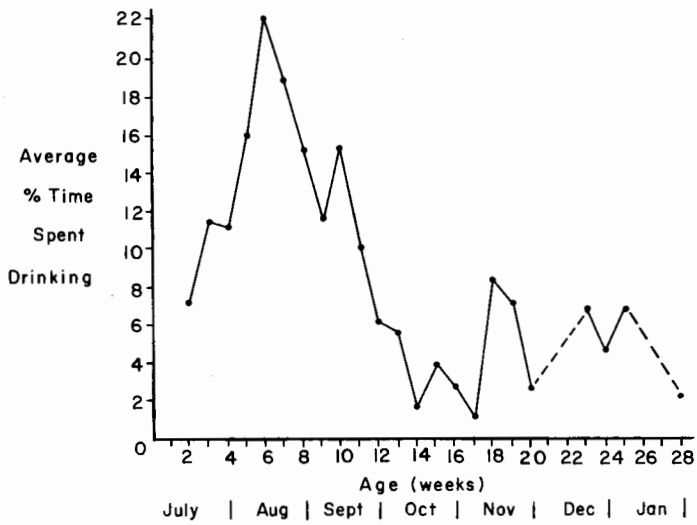


Fig. 3. The average percentage of time spent drinking as a function of age in weeks.

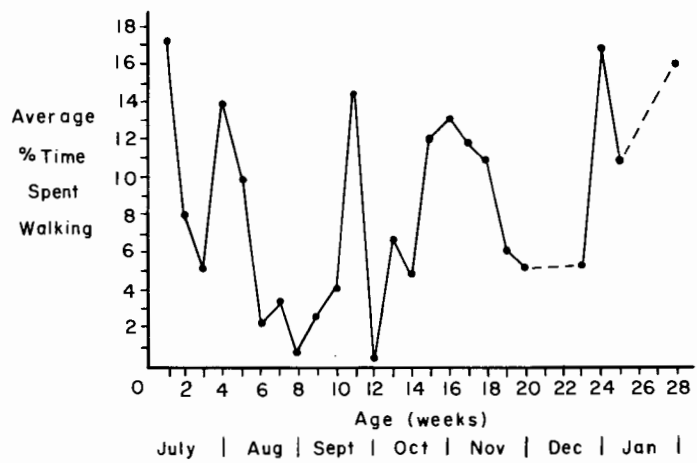


Fig. 4. The average percentage of time spent walking as a function of age in weeks.

m, which was equipped with a heat lamp, mirror, and food and water dishes. They were frequently allowed access to a large exercise yard, 30.5 m in diameter, with other chicks present. At 2–3 weeks, they were moved to an indoor–outdoor enclosure (indoor, 1.8 × 3 × 2.4 m; outdoor, 1.8 × 6 × 2.1 m) where they had visual contact with neighboring chicks. At 18–19 weeks, both birds were moved to a larger outdoor enclosure (18.3 × 18.3 m), which they shared with another red-crowned crane and a white-naped crane of about the same age. Their enclosure was bordered on three sides by a pair of adult sandhill cranes, a pair of adult red-crowned cranes, and five Siberian crane chicks.

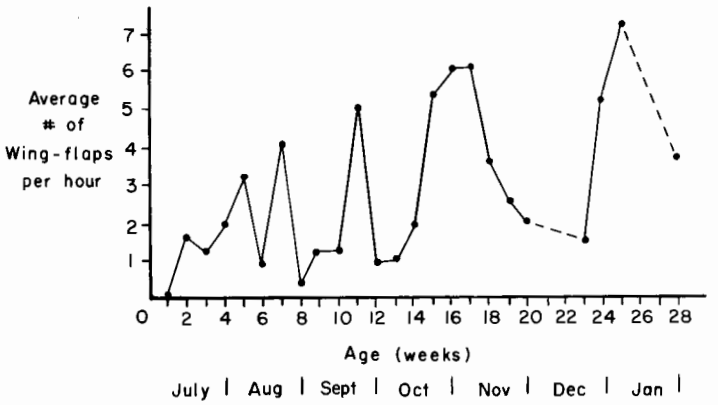


Fig. 5. The average number of wing-flaps per hour as a function of age in weeks.

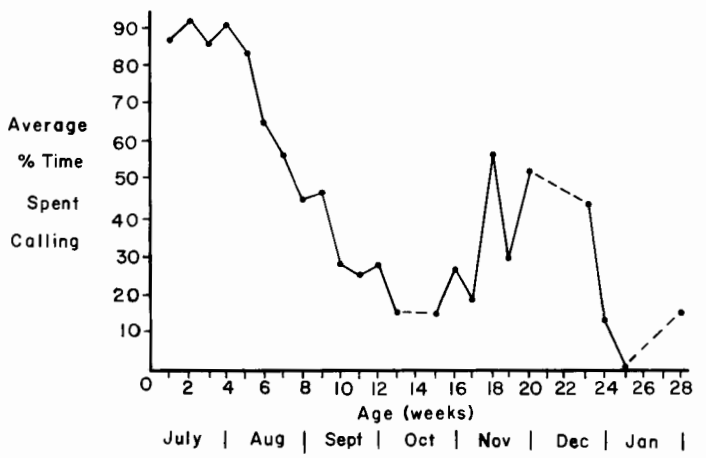


Fig. 6. The average percentage of time spent calling as a function of age in weeks.

Procedure

Each chick was observed for 1–2 hours twice a week. The behavior of each chick at the start of each 15-second period was classed as resting, sleeping, preening, feeding from the food dish, foraging, drinking, walking, or pacing the cage. Additionally, other behaviors were recorded when observed. These included feather ruffling, head shaking, wing flapping, head scratching, stretching (wing-leg or two-wing), yawning, and back slicking. Calling (peeping or purring) was also recorded when it occurred during any 15-second period. Interactions with other cranes within or between cages was recorded as a social interaction. Most were low-intensity aggressive interactions. The weights of each bird were also taken daily or weekly, and notes were made on feather development.

Analysis

Performance levels for each behavior were averaged for the two weekly sessions as the percentage of time spent in that activity or as the frequency of behaviors

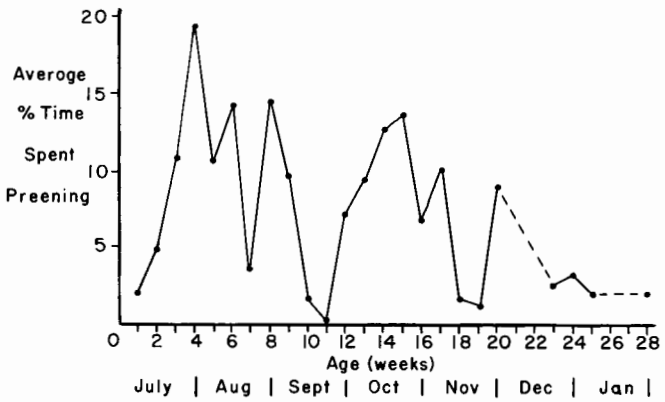


Fig. 7. The average percentage of time spent preening as a function of age in weeks.

occurring per hour. Because the two chicks' behavioral profiles were similar, weekly averages for both chicks were calculated.

RESULTS

Foraging included head movements, directing the bill at the ground or at other objects, interspersed with pecking or probing the ground. Feeding consisted of ingestion of the prepared diet from dishes. Combined, these activities exhibit a bimodal profile with peaks at weeks 5–10 and 19–28 (Fig. 1). Resting included lying on the breast, sitting on the hocks, or standing immobile on one or both legs. A sleeping bird was one resting with its eyes closed. Resting–sleeping peaks during the first 2 weeks, when the birds rested over 70% of the time (Fig. 2). A dramatic decrease occurred after 2 weeks, with a slight resurgence of resting at 11–12 weeks and 24–25 weeks. Drinking usually occurred with eating, so the trends are parallel with a major peak at 5–10 weeks and a second lesser peak at 18–25 weeks (Fig. 3).

Walking (Fig. 4) was noted whenever the chick walked or ran while not foraging. Walking peaks occur at weeks 1, 4, 15–18, and 24–28. The high at week 11 is probably a random peak caused by sampling. Wing-flapping, when chicks flapped while standing or running, parallels walking (Fig. 5).

Calling (Fig. 6), used in maintaining contact with the parents, was recorded within each quarter minute the chicks gave a peep or purr vocalization. The chicks show two main calling peaks, one at 5 weeks, when they called over 80% of the time, and again at 18–23 weeks, when they predominantly purred.

Preening included pulling at or stroking the feathers during any quarter minute period. It usually occured in long continuous bouts, so the percentage is close to the actual time spent preening. Preening (Fig. 7) exhibits a bimodality with high levels at 3–9 weeks and 13–17 weeks.

At times the chicks showed stereotyped pacing along the cage walls by walking back and forth along the wire, rubbing the neck and breast upward against the wire, or stepping one foot up againt the wire. Pacing seemed related to a fearful stimulus or to a desire to be let out with the other chicks and their caretaker in the exercise yard, and it was often a good indicator of insecurity. Pacing (Fig. 8) shows a gradual increase to a single peak at week 13, with a possible earlier period at 3 weeks.

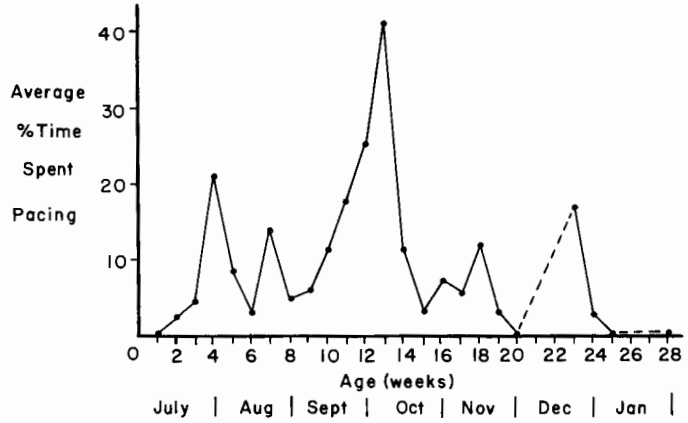


Fig. 8. The average percentage of time spent pacing as a function of age in weeks.

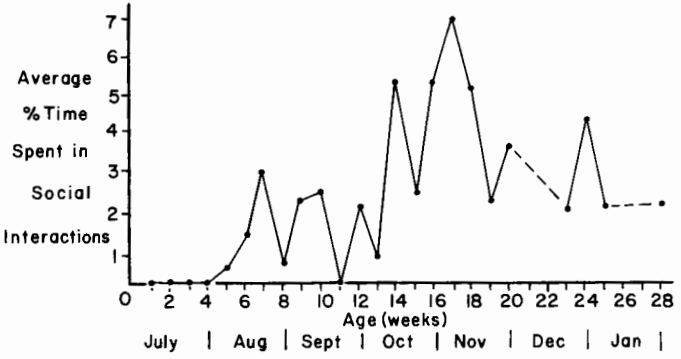


Fig. 9. The average percentage of time spent in social interactions as a function of age.

Social interactions included giving or receiving: pecking at, chasing, or displacing another bird during any quarter minute. The older male was dominant over the female. Their interactions gradually increase to a peak at weeks 14–18, with a reduction after that. There may be an earlier, lesser peak at 5–9 weeks as well.

Shakes included shaking or ruffling the head and body. Most shakes occur during the first week and gradually decline (Fig. 10). Head scratching (Fig. 11) increases after the second week and remains high until week 14, after which it declines.

Three typical avian stretches were lumped: yawning (a wide opening of the bill), bending forward while lifting both wings upwards, and simultaneous stretching of the leg and wing on the same side of the body, backwards. Stretches peak at weeks 2–3, but remain high until week 9, after which they decline (Fig. 12).

Both weight gain (Fig. 13a) and actual weight (Fig. 13b) of the male and female bifurcate after 6 weeks, perhaps indicating the start of sexual dimorphism. Weight gain, following foraging, increases until 10 weeks, after which both foraging and weight gain diminish.

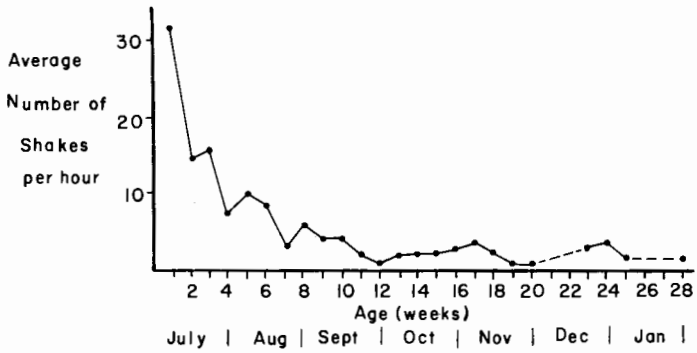


Fig. 10. The average frequency of shakes per hour as a function of age in weeks.

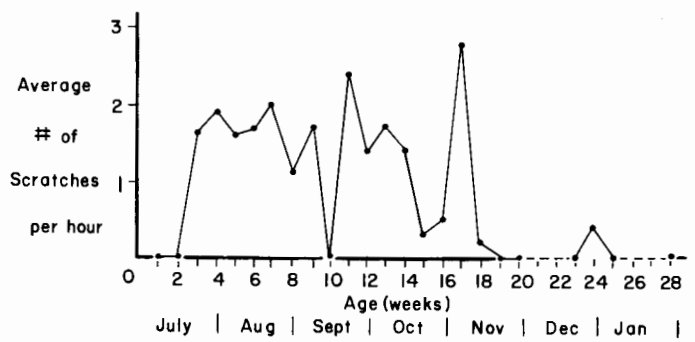


Fig. 11. The average number of scratches per hour as a function of age in weeks.

DISCUSSION

Although commonly observed in mammals [Horwich, 1974a], cycles in performance levels during development are not well known in birds. While reworking data on wing-flashing rates in mockingbirds [Horwich, 1965], I noted cyclic performance peaks. Voss' data [1979] for sandhill cranes also showed peaks and valleys in foraging and preening rates. These observations encouraged me to gather comparative data for red-crowned cranes. Only Ellis' study [1979] of golden eagle chicks specifically noted and discussed the phenomenon of cyclic development. He noted six basic types of behavioral performance profiles: 1) behaviors that occur at high rates at hatching and gradually disappear, 2) cyclic profiles that drop to zero, 3) behaviors that peak and disappear, 4) behaviors that peak and drop to a lower adult level, 5) cyclic behaviors that drop to a lower level, and 6) behaviors that start at zero and increase to an adult level. Although the red-crowned data conform to Ellis' curve types, I prefer to use only four basic profiles, eliminating those that differ in degree only. I lump Ellis' types 2 and 5 into cyclic behaviors and types 3 and 4 into behavioral peaks, because behaviors are usually never lost but reappear under the right circumstances. They may reappear in modified form, in different circumstances, or are performed at such low levels they are not detected during observation periods.

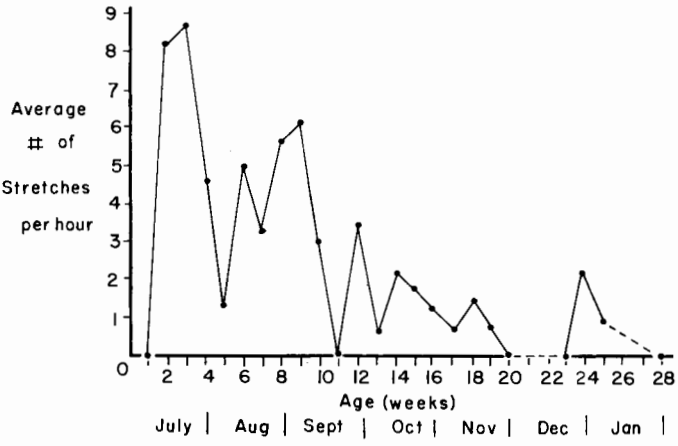


Fig. 12. The average frequency of stretches per hour as a function of age in weeks.

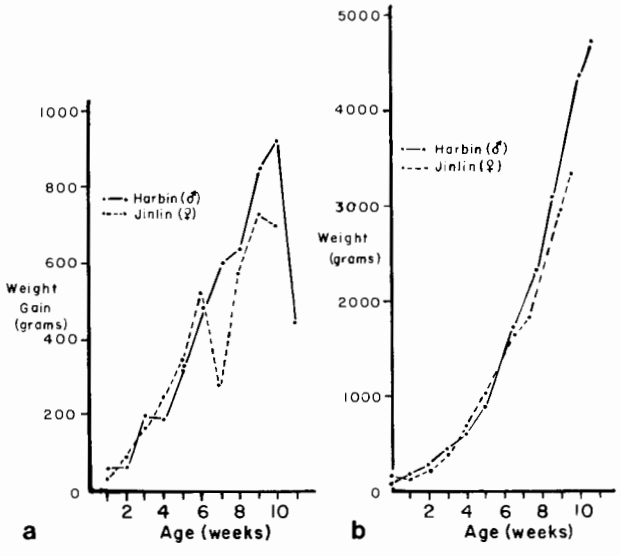


Fig. 13. **a:** The weekly gain in grams as a function of age in weeks. **b:** The weekly weight in grams as a function of age.

In the red-crowned cranes, six behaviors were cyclic. Walking, calling, and resting all showed initial high periods after hatching, indicating their importance in the young chick's behavior (Fig. 14). Resting was extremely high during the first few weeks, with smaller peaks later. However, walking and calling are necessary in early development for imprinting and in following the parent to obtain food. The other four cyclic behaviors (foraging, drinking, preening, and wing flapping) show specific cyclic peaks throughout the ontogeny. The second highest class of developmental profiles included behaviors with single main peaks (social interactions, stretching, and scratching). Despite their reduction to near zero levels, all these behaviors do

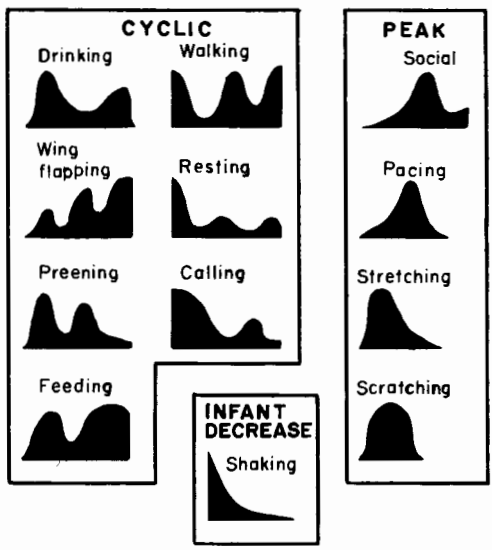


Fig. 14. The general profiles of behavioral development in two red-crowned cranes arranged according to profile types: cyclic, peaked, and infantile decrease.

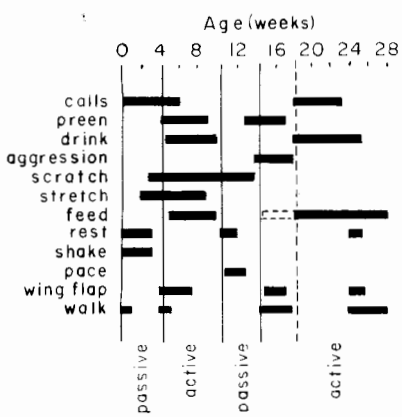


Fig. 15. The estimated age peaks of red-crowned crane behaviors as a function of age in weeks. The peaks indicate an alternation of passive and active age periods.

occur in adult birds and probably never reach a zero level. There is also some indication that pacing and social interactions had earlier peaks at 3 and 6–10 weeks, respectively, indicating a tendency to cycle. Finally, only shaking showed the early infantile high profile, with a radical decrease in frequency after the first week.

Red-crowned cranes show a tendency to alternate between periods of activity and passivity similar to a spectacled langur, *Presbytis obscurus* [Horwich, 1974b] (Fig. 15). The passive tendency is especially apparent during the first few weeks of neonatal life, when calling rates are high, enabling the chick to remain in close contact with its parents. Shakes are also high from 0–4 weeks. The second period, of high activity and involving foraging, drinking, scratching, stretching, preening, and wing

flapping, occurs from 4–10 weeks. Thereafter, resting, scratching, and pacing again become more important. Although pacing is a very active behavior, I interpret high pacing rates as an indication of social stress. Very likely, if the chick had parents, pacing would have been nonexistent and would have been replaced by closeness to the parents, similar to the langur [Horwich, 1974b]. Finally, after 14 weeks, another active period begins, which includes preening, agonistic interactions, wing flapping, feeding, drinking, and calling. By this time calling has changed to purring contact or contentment calls given while feeding.

A major complication in interpreting these behavioral profiles is the absence of the parents. While hand-reared chicks often call continuously, a parent-reared white-naped crane called in synchrony with its parents, indicating that calling rates for parent-reared chicks may be much lower than those of hand-reared chicks. In contrast, performance rates in walking and wing flapping coincided with fledging at 15–17 weeks. A second peak at 24–28 weeks coincided with the time when migration in the wild would be occurring, considering that these chicks hatched 1.5 months later than in the wild in Russia [Viniter, 1981]. It is clear that many behaviors show cyclic profiles. When comparable data are available for parent-reared chicks, especially in the wild, the significance of these trends will become more apparent.

CONCLUSIONS

1. Red-crowned cranes show cyclic behavioral development.
2. Other developmental profile types include 1) behaviors that show one major peak in performance rate and 2) behaviors that are initially important but are later performed at lower rates.
3. At a higher level of organization than the action pattern, red-crowned crane chicks seem to alternate between passive and active periods, each being a few weeks in duration.

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