

## Preliminary Study on the Level of Evolutionary Differentiation between Domestic Quails and Wild Japanese Quails

H. Y. Wang, H. Chang\*, W. Xu, G. B. Chang, S. X. Lu, L. Du, W. Sun, M. Xu and Q. H. Wang

Animal Science and Veterinary Medicine College, Yangzhou-University, Yangzhou-city

Jiangsu Province 225009, P. R. China

**ABSTRACT :** This paper makes an analysis of the ecological behaviours of 3 categories of quails, namely wild Japanese quails from the Weishan Lake Area, medium-sized domestic quails and pint-sized domestic quails. The study indicates as follows: (1) There is difference in morphological and biological habits between domestic quails and wild Japanese ones. (2) The cross-breeding between the wild and domestic quails is a cross from exclusion to affinity. (3) The behaviours of quails such as pursuit, paw and mating are selective. (4) The wild Japanese quails and domestic ones can succeed in mating and in reproducing fertilized eggs but with a low rate. (5) Evolutionary differentiation has been formed in varying degrees between the domestic quails and their wild ancestors in morphological and ecological characteristics. (*Asian-Aust. J. Anim. Sci.* 2003, Vol 16, No. 2 : 266-268)

**Key Words :** Wild Japanese Quails in the Weishan Lake Area, Medium-Sized Domestic Quails, Pint-Sized Domestic Quails, Level of Evolutionary Differentiation

### INTRODUCTION

Quails (*Coturnix coturnix japonica*), which belong to Coturnix, Phasianidae, Calliformes, Aves, have developed into two species in orient-Asia named Common quails (*Coturnix coturnix*) and Japanese quails (*Coturnix japonica*) (Check-list of North American Birds, 1983; Chang, 1995). Domestic quails, derived from Japanese quails, as laying, meat and laboratory animals with special value, have produced a flourishing industry (Lin, 2000; Chang et al., 2001a). Revealing the level of the two species' evolutionary differentiation on ecological behaviours and hybrid fertility will help to strengthen the quail industry and promote effective protection and exploitation of quail genetic resources. It can also add to data about quails' behaviours, the phylogenetic relationship and systematic divergence between wild and domestic quails, and the domestic quails' changes during their domestication and improvement.

### MATERIALS AND METHODS

#### Materials, sampling methods

The experimental wild Japanese quails were captured during their migrate seasons from Weishan Lake Area on the borders of Jiangsu, Shandong and Anhui provinces (Chang et al., 2001). The domestic ones were obtained from a local aviary. After being vaccinated and accustomed to cage life, each quail was tested for body weight and size measure (Chang et al., 2000c) and then divided into groups, each group with one male to multiple females (Wechsler,

1998) as shown in Table 1.

#### Management

Quails were fed in single-layer cages, with regular food and water. Cages were cleaned every day. Their behaviours were continuously observed and recorded from 06:00 to 19:00 h, from 23 May to 19 September in 2001, a total of 120 days.

#### Observation items

*The First kind of behaviours :* exclusion (including fight, peck and elusion);

*The Second kind of behaviours :* affinity (including approach, pursuit, paw and mating);

*Laying behaviours :* laying time, laying individual.

#### Data treatment

The behavioural data were treated with Excel and GLM program in SAS:

Fertility rate % = fertilized eggs/hatched ones  $\times$  100;

Hatchability percentage = survival quails/hatched eggs  $\times$  100;

Hatching rate of fertile eggs % = survival quails/fertility eggs  $\times$  100 (Lin, 2000).

### RESULTS

#### Comparison of biological features between wild and domestic quails

Easily scared and capable of flying, the wild Japanese quails in Weishan Lake Area are sensitive to the circumstances and fond of clustering. They differ from domestic quails in appearance, weight, adaptation, behaviours and the like. Due to their short-period of

\* Address reprint request to H. Chang, Tel: +86-514-7979350, Fax: +86-514-7350440, E-mail: yjshywang@sina.com

Received June 25, 2002; Accepted September 11, 2002

**Table 1.** The experimental groups of quails

	M group Medium- sized domestic quail (1♂)	P group Pint-sized domestic quail (1♂)	W group Wild quail (1♂)
Medium-sized domestic quails (♀)	3	3	3
Pint-sized domestic quails (♀)	3	3	3
Wild quails (♀)	2	2	2

domestication, some behaviours of domestic quails are still somewhat wild, such as nervousness, early maturity, selective mating, the male's tendency to fight.

### The cross from exclusion to affinity

The exclusionary behaviours such as fighting and pecking took place at the initial stage of experiments. With the passage of time, the rate of their occurrence declined and they were gradually replaced by pursuit, paw and mating. This does not demonstrate any obvious social hierarchy, i.e. selectiveness. It may be a process of adapting to each other. Of all these behaviours, fighting rarely occurs, which is perhaps attributed to group division because of the male's belligerent and gluttonous inclination to fight and feed (Xie, 1995).

### Statistical analysis of pursuit, paw and mating

The results are shown in Table 2 and 3. From Tables 2 and 3, such analysis can be made.

*Pursuit* : The males pursued the pint-sized domestic females, the medium-sized domestic ones and the wild females in varying degrees of intensity. But there was no obvious difference among the three types of females ( $p>0.05$ ). The medium-sized domestic males' pursuit frequency was higher than the other two males, but there was no difference between the latter. This indicates that body size is an obstacle to successful mating.

*Paw* : In general, there was no obvious difference between the medium-sized and pint-sized domestic male quails, that is, they have random selection for the females ( $p>0.05$ ). The wild female quails have the least paw behaviours, substantially lower than the other two types of females ( $p<0.05$ ), but no obvious difference was observed between the two types of females ( $p>0.05$ ). Of all the

crossing-groups,  $a_3 \times b_2$  is the most active in pawing, distinctly higher than the others ( $p<0.01$  or  $p<0.05$ ) with the exception of  $a_1 \times b_1$ .

*Mating* : The males have much higher mating frequency with the wild female than the other two females ( $p<0.05$ ). Of all the crossing-groups, the highest mating frequency was observed in  $a_3 \times b_2$ , showing significant difference from  $a_3 \times b_1$  ( $p<0.05$ ) and  $a_3 \times b_3$  ( $p<0.01$ ). There was no obvious difference between the domestic quails ( $p>0.05$ ).

### Statistics of laying (The results are shown in Table 4.)

The quails generally lay eggs after noon, mostly after 15:30. According to Table 4, the fertility rate in W group was significantly lower than other groups ( $p<0.05$ ).

## DISCUSSION

The statistical results of pursuit, paw and mating show that the spouse choosing inclination gradually increases. The wild male did not show a significant difference in pursuing the pint-sized domestic females, but reflects significant affinity in paw and mating. The data also show a relatively lower ethological isolation between the wild and the pint-sized domestic quails than other groups. This is probably due to the little difference in size and the lower level of evolutionary differentiation between them. There is no significant differentiation between the two domestic populations. In addition, the results of mating and laying indicate that mating is feasible between the domestic and wild quails and that gene exchange can take place under certain circumstances. But between the two colonies there has been formed differentiation in appearance and ecological characteristics, which to some extent has affected the crossbreeding fertility. The rate of successful mating needs to be clarified. Further research and discussions are required to account for the few behaviours of the wild females.

Fuzzy cluster analysis and polymorphism examination of encoding the enzymes in viscera and muscle show that there is a close phylogentic relationship between the wild Japanese quails in Weishan Lake Area and the domestic quails. However, it has become estranged due to the long-term evolution (Akiko, 1994; Sano, 1995; Chang et al., 2001d). The study also indicates that the two populations have possessed a certain lower differentiation in terms of size, colour and biological characteristics. The lower

**Table 2.** The statistical analysis of pursuit, paw and mating of quails Unit:times/one quail, 30 days

	Pursuit		Paw		Mating	
	♂	♀	♂	♀	♂	♀
M group	8.933±0.432 <sup>a</sup>	3.058±0.392 <sup>a</sup>	6.800±0.491 <sup>a</sup>	8.000±0.444 <sup>ab</sup>	23.325±2.233 <sup>d</sup>	5.442±3.105 <sup>d</sup>
P group	1.208±0.184 <sup>b</sup>	5.183±0.559 <sup>a</sup>	3.900±0.415 <sup>a</sup>	12.242±1.788 <sup>a</sup>	21.950±3.302 <sup>d</sup>	1.158±3.455 <sup>d</sup>
W group	0.642±0.062 <sup>b</sup>	2.542±0.428 <sup>a</sup>	9.958±1.889 <sup>a</sup>	0.417±0.073 <sup>b</sup>	31.658±3.956 <sup>b</sup>	0.333±0.049 <sup>b</sup>

The same letters mean insignificant difference ( $p>0.05$ ). The different letters mean significant difference ( $p<0.05$ ).

**Table 3.** The least square means estimation of each group's behaviours unit:times/one quail: 30 days

Crossmating groups	N	Pursuit	Paw	Mating
a <sub>1</sub> ×b <sub>1</sub>	3	7.900 <sup>aAC</sup>	11.325 <sup>abAB</sup>	40.425 <sup>abABD</sup>
a <sub>2</sub> ×b <sub>1</sub>	3	0.675 <sup>bb</sup>	8.000 <sup>aAB</sup>	47.575 <sup>abAD</sup>
a <sub>3</sub> ×b <sub>1</sub>	3	0.600 <sup>bb</sup>	4.675 <sup>aa</sup>	18.325 <sup>acAB</sup>
a <sub>1</sub> ×b <sub>2</sub>	3	12.150 <sup>ca</sup>	8.325 <sup>aAB</sup>	29.175 <sup>acAB</sup>
a <sub>2</sub> ×b <sub>2</sub>	3	2.575 <sup>bbD</sup>	3.575 <sup>aa</sup>	17.900 <sup>acAB</sup>
a <sub>3</sub> ×b <sub>2</sub>	3	0.825 <sup>bb</sup>	24.825 <sup>aa</sup>	76.400 <sup>bD</sup>
a <sub>1</sub> ×b <sub>3</sub>	2	6.750 <sup>aDC</sup>	0.750 <sup>aa</sup>	0.375 <sup>cB</sup>
a <sub>2</sub> ×b <sub>3</sub>	2	0.375 <sup>bb</sup>	0.125 <sup>bb</sup>	0.375 <sup>cB</sup>
a <sub>3</sub> ×b <sub>3</sub>	2	0.500 <sup>bb</sup>	0.375 <sup>aa</sup>	0.250 <sup>cB</sup>

The same letters mean insignificant difference ( $p > 0.05$ ). The different letters mean significant difference (The capital letters represent  $p < 0.01$ , otherwise,  $p < 0.05$ ).

a<sub>1</sub>, a<sub>2</sub>, a<sub>3</sub>, b<sub>1</sub>, b<sub>2</sub>, b<sub>3</sub> respectively represents the Medium-sized domestic quails (♂), the Pint-sized domestic quails (♂), the Wild quails (♂), the Medium-sized domestic quails (♀), the Pint-sized domestic quails (♀) and the Wild quails (♀).

**Table 4.** Each group's fertility, hatching and fertile eggs' hatching rates

	Fertility rate (%)	Hatching rate (%)	Hatching rate of fertile eggs (%)
M group	64.80 <sup>a</sup>	21.34 <sup>a</sup>	33.86 <sup>a</sup>
P group	72.24 <sup>a</sup>	32.32 <sup>a</sup>	44.74 <sup>a</sup>
W group	11.88 <sup>b</sup>	4.21 <sup>b</sup>	35.48 <sup>a</sup>

The different letters mean significant difference ( $p < 0.05$ ). The same letters mean insignificant difference ( $p > 0.05$ ).

evolutionary level of the wild and the pint-sized quails may have resulted in gene change in quail populations accidentally carried by weight selection (Cheng et al., 1992; Zheng, 1994). There is no obvious divergence between the medium-sized and pint-sized domestic quails.

The long-period domestication of quails has caused difference from the wild populations, but they still retain some wild characteristics (Lin, 2000). Ethological isolation has formed during the evolutionary course between the domestic quails and their wild ancestors, i.e. the Japanese quails. It may be one of the factors that such kind of genetic divergence boosts to form the mechanism of prezygotic RIM.

## REFERENCES

- Akiko Sano, Naoki Goto and Masao Kimura. 1994. Genetic Differentiation within Commercial Quail Populations. *Jpn Poult. Sci.* 31:276-286.
- American Ornithologists Union. 1983. Check-list of North American Birds. Allen Press, Inc., Lawrence, Kansas, USA.
- Chang, G. B. 2001. Study on Phylogenetic Relationship Between Wild Japanese Quails in the Weishan Lake Area and Domestic Quails. Yangzhou University, Yangzhou, China. The papers of Masters Degree in 2001.
- Chang, G. B., H. Chang and H. L. Zheng et al. 2001a. Study on Phylogenetic Relationship Between Wild Japanese Quails in the Weishan Lake Area and Domestic Quails. *Asian-Aust. J Anim. Sci.* 14:603-607.
- Chang, G. B., H. Chang and X. P. Liu. 2001b. Origin and evolution of quails. *China Poultry.* 23(10):49-50.
- Chang, G. B., H. Chang and X. P. Liu et al. 2001d. Study on origin and phylogeny of wild quails in China. *Jiangsu Agricultural Research.* 22:53-57.
- Chang, H. 1995. Essentials of Animal Genetic Resources Science. Agricultural Publishing House of China (1<sup>st</sup> Ed.), pp. 93-133.
- Chang, H., Mimachirer and Y. X. Li et al. 2001c. Linzhi native pig-an investigation report on new genetic resource of livestock. *Asian-Aust. J. Anim. Sci.* 14:1203-1208.
- Cheng, K. M., M. Kimura and S. Fujii. 1989. A comparison of genetic variability in strains of Japanese quail selected for heavy body weight. *J. Hered.* 83:31-35.
- Lin, Q. L. 2000. Feeding Quails with High Efficiency. Jindun Publishing House of Nanjin, China. pp.1-21.
- Sano, A. and T. Okamoto et al. 1995. Genetic differentiation among laboratory quail populations. *Jpn Poult. Sci.* 32:177-183.
- Xie, C. X. 1995. History of China Poultry. Agricultural Publishing House of China. pp. 94-102.
- Wechsler, B. and I. Schmid. 1998. Aggressive pecking by males in breeding groups of Japanese quail (*Coturnix japonica*). *Br. Poult. Sci.* 39:333-339.
- Zhang, J. H., T. P. Cheng and J. K. Liu. 2000. Observation of affinity in the course of cross breeding between Mallard and Beijing duck. *Ecology of Domestic Animal.* 21:10-15.
- Zheng, H. L. Study on Allozyme Polymorphism in Viscera and Muscle of Two Quails Strains for Egg. Northwestern Agricultural University, Shanxi, China. The papers of Masters Degree in 1997.