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Keywords: aggressive behavior/Eurasian lynx/Iberian lynx/Lynx lynx/Lynx pardinus/siblicide

Abstract: Early sibling fights in Eurasian and Iberian lynxes differ from other types of behavior in a lack of ritualized elements (threats) and a high motivation level. In 2005 sudden aggression, which ended up in siblicide, took place in the first Iberian lynx litter born in captivity. Fights became a problem, turning into one of the highest risks of mortality for captive born cubs. Fights started spontaneously, without any indication of previous aggression, with a very sudden and fast attack of one of the cubs in the litter. This aggression did not take place while the cubs were nursing or eating, and it did not appear to be caused by any kind of competition. Fights were not the result of an escalation of other social interactions, most times they occurred without any previous interaction (e.g., while one of the cubs was sleeping or just sitting, looking away). Litter size didn't influence fight probability or cub mortality in any of the two species. Age at which fights occurred varied from 36-64 day in Eurasian lynx litters. In naturally raised Iberian lynxes, the appearance of sibling fights was observed during 36-63 days of life. In general, fights occurred between the 6th and 8th week of the cub's life in 90% of the Eurasian cases (18/20), but mostly during the seventh week. In Iberian lynx litters, 77% (10/13) of fights also occurred between the 6th-8th postnatal weeks, being more frequent during the 6th week. Duration of after-fight aggression varied across Iberian lynx litters (median=14; min=1; max=95 days). The aggressive period in Iberian lynx lasted around 63 days (min=45; max=144). The number of attacks was higher in Eurasian than in Iberian lynx fights, but the after-fight aggressive period in Eurasian lynx was much shorter than in the Iberian lynx. Both differences could be caused by either the after-fight husbandry procedures used in the endangered species or by species-specific differences. Although fights occurred between cubs of the same and different genders, body size made a difference. Female cubs were aggressors more often than males in Eurasian lynx and the opposite was true for Iberian lynx litters. Sex ratio of aggressors did not differ from overall sex ratio in lynx litters. In general, the aggressor was larger than the attacked cub. Although several characteristics differ between Eurasian and Iberian lynx fights, this phenomenon is similar in both species, yet it differs from sibling aggression in other taxa.

Notes: Incl. Spanish abstract

A comparative note on early sibling aggression in two related species: the Iberian and the Eurasian lynx

Nota comparativa sobre la agresión precoz entre hermanos de camada en dos especies afines: el lince ibérico y el lince euroasiático

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RESUMEN

Las peleas precoces entre hermanos de camada en el lince euroasiático y el lince ibérico se distinguen de otros tipos de comportamiento agonístico por la ausencia de elementos rituales (amenazas) y por su alto nivel de motivación. En 2005, se observó una agresión súbita que acabó en fratricidio en la primera camada de lince ibérico nacida en cautividad. Este fenómeno se ha convertido en un desafío para este Programa y actualmente constituye uno de los mayores riesgos de mortalidad de cachorros nacidos en cautividad. Las agresiones se inician de forma espontánea, sin ninguna indicación de agresión anterior, con un ataque repentino y rápido por parte de uno de los cachorros de la camada. Las agresiones observadas nunca han tenido lugar mientras los cachorros se alimentaban y no parecen haber sido causadas por ningún tipo de competencia por el alimento. En ocasiones, las peleas tuvieron lugar tras la intensificación de otras interacciones sociales, pero en otras muchas se produjeron sin interacción previa (p.ej., cuando uno de los cachorros estaba durmiendo o simplemente sentado mirando hacia otro lado). El tamaño de la camada no influye sobre la probabilidad de peleas ni sobre la mortalidad de los cachorros en ninguna de las dos especies. La edad a la cual se produjeron las agresiones oscila entre 36 y 64 días en camadas de lince euroasiático. En el lince ibérico, dichas agresiones se observaron entre los 36 y 63 días de vida. En general las peleas entre hermanos tuvieron lugar entre la sexta y la octava semana de vida en cachorros de lince euroasiático (90% de los casos), aunque se dieron con mayor frecuencia durante la séptima semana de vida. En el lince ibérico, el 77% de las peleas tuvieron lugar entre la sexta y la octava semana de vida, siendo más frecuentes durante la sexta semana.

La duración del período agresivo posterior a una pelea varía entre camadas de lince ibérico (media=14; mín =1; máx=99 días). El periodo agresivo en el lince ibérico duró alrededor de 63 días (mín=45; máx=144) El número de ataques fue mayor en las peleas entre cachorros de lince euroasiático que en las de lince ibérico, pero el período agresivo posterior a las peleas fue mucho más corto en el lince euroasiático que en el ibérico. Ambas diferencias podrían deberse o bien al uso de distintas técnicas de manejo tras las peleas observadas en la especie amenazada, o bien a características específicas de cada especie. Aunque el sexo del cachorro no influyó sobre su papel en las peleas (agresor o víctima), el peso corporal sí resultó ser un factor importante. Las hembras fueron agresoras con mayor frecuencia que los machos en cachorros de lince euroasiático, mientras que en el lince ibérico se produjo el fenómeno contrario. La proporción de sexos de los agresores fue la misma que la proporción de sexos total en las camadas de lince. En general, antes de la pelea, el peso del agresor era mayor que el del cachorro atacado. Aunque existen algunas diferencias entre las peleas de lince euroasiático e ibérico, este fenómeno es similar en ambas especies y se diferencia claramente de la agresión entre hermanos de camada observada en otros grupos taxonómicos.

PALABRAS CLAVE

Lince ibérico, lince euroasiático, fratricidio, comportamiento agresivo

ABSTRACT

Early sibling fights in Eurasian and Iberian lynxes differ from other types of behavior in a lack of ritualized elements (threats) and a high motivation level. In 2005 sudden aggression, which ended up in siblicide, took place in the first Iberian lynx litter born in captivity. Fights became a problem, turning into one of the highest risks of mortality for captive born cubs. Fights started spontaneously, without any indication of previous aggression, with a very sudden and fast attack of one of the cubs in the litter. This aggression did not take place while the cubs were nursing or eating, and it did not appear to be caused by any kind of competition. Fights were not the result of an escalation of other social interactions, most times they occurred without any previous interaction (e.g., while one of the cubs was sleeping or just sitting, looking away). Litter size didn't influence fight probability or cub mortality in any of the two species. Age at which fights occurred varied from 36-64 day in Eurasian lynx litters. In naturally raised Iberian lynxes, the appearance of sibling fights was observed during 36-63 days of life. In general, fights occurred between the 6th and 8th week of the cub's life in 90% of the Eurasian cases (18/20), but mostly during the seventh week. In Iberian lynx litters, 77% (10/13) of fights also occurred between the 6th-8th postnatal weeks, being more frequent during the 6th week. Duration of after-fight aggression varied across Iberian lynx litters (median=14; min=1; max=95 days). The aggressive period in Iberian lynx lasted around 63 days (min=45; max=144). The number of attacks was higher in Eurasian than in Iberian lynx fights, but the after-fight aggressive period in Eurasian lynx was much shorter than in the Iberian lynx. Both differences could be caused by either the after-fight husbandry procedures used in the endangered species or by species-specific differences. Although fights occurred between cubs of the same and different genders, body size made a difference. Female cubs were aggressors more often than males in Eurasian lynx and the opposite was true for Iberian lynx litters. Sex ratio of aggressors did not differ from overall sex ratio in lynx litters. In general, the aggressor was larger than the attacked cub. Although several characteristics differ between Eurasian and Iberian lynx fights, this phenomenon is similar in both species, yet it differs from sibling aggression in other taxa.

KEYWORDS

Iberian lynx, Eurasian lynx, siblicide, aggressive behavior

A comparative note on early sibling aggression in two related species: the Iberian and the Eurasian lynx

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INTRODUCTION

Early sibling aggression in Lynx (*Lynx lynx*) was described at Tchernogolovka biological station (Sokolov et al., 1994; Naidenko and Antonevich, this book). These fights differed from the other types of behavior in that cubs were focused on aggressive interactions that lacked ritualized elements such as threats. This kind of sibling interaction is known mostly from bird species, and it is rarely seeing in mammals (Drummond, 2006). Overwhelming advantages are expected for the winner in such a strongly exposed competition and studies about sibling fights in Eurasian lynx revealed some of them (Naidenko and Antonevich, this book). In 2005 sudden aggression appeared in the first Iberian lynx (*Lynx pardinus*) litter born in captivity (Vargas et al., 2005). This fight ended up in siblicide, with the death of the largest female in the litter. Ever since, fights have become a husbandry challenge, revealing a potentially high risk of mortality for captive-born Iberian lynx cubs. In 2007, a study of early sibling aggression on Iberian lynx was started with the purpose of developing husbandry strategies for countering cub fights while applying knowledge from siblicide in Eurasian lynx to its endangered sister taxa. The study aimed at comparing the main features of early sibling aggression in Eurasian and Iberian lynx.

MATERIALS AND METHODS

The study on Eurasian lynx was conducted at the “Tchernogolovka” biological station, Russia (see details in Naidenko and Antonevich, this book). The Iberian lynx study was held at El Acebuche Breeding Center, in Doñana, Huelva. In Iberian lynx litters and paired hand-raised cubs, 24-hour video-monitoring provided us with detailed information about cub development, including fighting behavior (Vargas et al., this book).

We used different approaches to manage Eurasian and Iberian lynx litters during fights. In the Eurasian lynx, managers usually did not intervene during fights nor did they separate cubs after fighting. After the first few fights, managers soon realized that those aggressive encounters were more of a rule rather than just pure accident. Since then, human intervention would only take place if Eurasian lynx cubs were severely injured during the fights.

As for Iberian lynx fights, given that the first fight that ever took place in the Breeding Programme resulted in

the death of a cub, aggressive cubs were often separated from the others, in order to prevent the risk of severe injuries and/or death of the attacked cub. After-fight husbandry involved maintaining both cubs separated from each other and taking turns with their mother. Cubs were allowed to see and contact each other and their mom through the mesh, which impeded the potential for fighting, but kept the litter united. Switching cubs occurred between two and four times per day. Cubs were put together regularly to check if they had overcome the aggressive period. Once cubs had settled their differences, the family unit was brought back together.

Fight cases in Eurasian lynx litters were recorded from 1989 to 2007. In 2003-2007 a thorough study aimed at studying fights led to the observation of 15 Eurasian lynx litters. Iberian lynx litters included in this study were monitored between 2005 and 2008. Altogether, eight naturally-raised litters of 2-3 cubs and six hand-raised cubs paired in different ways were monitored. Duration of the aggressive period was estimated by calculating the time elapsed between the first fight and the first reunion where cubs did not fight. In hand-raised cubs, there was a pair of cubs that were not to put back together. In this case we used the last known attempt of reunion even unsuccessful as the last known day of aggression.

RESULTS AND DISCUSSION

CONTEXT

In the Eurasian lynx, fights occurred in 53% (19/36) of litters of 2-4 cubs. The frequency of fights was higher in the years of precise cubs observations (67%, n=15). Litters with triplets had fights slightly more often than litters with twins (65% vs 39% of litters, respectively; P=0.08). However, litter size ratio is biased towards triplets (8/3-triplets/twins) in the years of precise observations. Such bias could cause underestimation of the probability of fights in twins. Mortality was not related to litter size (Naidenko and Antonevich, this book). Overall mortality rate was 5% of cubs. When taking into account all litters raised at the Tchernegolovka facility (n=36), siblicide occurred in 14% of all litters, which included 5% of all cubs born at the facility. When only taking into account cub mortality in litters where fights occurred (n= 19 litters), siblicide occurred in 20% of the fighting litters, i.e., in 9% of the cubs that fought.

Fights occurred in six of the seven naturally-raised Iberian lynx litters (86%). Among the six hand-raised male cubs, four different combinations of paired-cubs took place during the process of looking for compatible pairs. Also, a hand-raised female born in 2007 was paired with a 1-week younger bobcat female cub. Strong spontaneous aggression occurred in all paired hand-raised cubs, in some cases right after nursing from the bottle. Litter size ratio of aggressive naturally-raised litters was 5:1 (twins: triplets), and only one litter with triplets never had a fight. Cubs died from fighting-induced trauma in two litters. In the first case, one cub severed the others' trachea and perforated its skull (Vargas et al., 2005) and in the other case, it was the mother who inflicted the lethal wounds on her cub while trying to separate her fighting offspring. Husbandry methods in all Iberian lynx litters were geared to prevent any potential deaths, so it is not possible to evaluate the actual mortality rate from these fights.

AGE OF FIGHTS

The age of fights varied from 36-64 day in Eurasian lynx litters. In Iberian lynx, the first fights were observed between 38-63 days of life. In hand-raised Iberian lynx cubs, fights occurred between 42-56 days of life, except for one cub that had been paired with a 1-week younger bobcat cub (for lack of another Iberian lynx cub) and fought at 74 days of age. Fights occurred between the 6th and 8th week of the cub's life in 90% of the Eurasian cases (18/20), but mostly during the seventh week (55% of cases; i.e., 11/20; chi-square=15.31; p<0.01). In Iberian lynx litters, 77% (10/13) of fights also occurred between the 6th-8th postnatal weeks.

FIGHT FEATURES

Every fight in both Eurasian and Iberian lynx litters consisted of several attacks. We considered one full attack to take place from the onset of fighting to the moment when the mother separated the cubs; if the cubs initiated another bout of fighting that would be considered another attack. We calculated the number of attacks for each fight in Eurasian lynx litters (median=5; min=2; max=18; n=6) and in Iberian lynx litters (median=3.5; min=2; max=7; n=6) in all the cases where it was possible to see. In Eurasian lynx litters, cubs remained aggressive

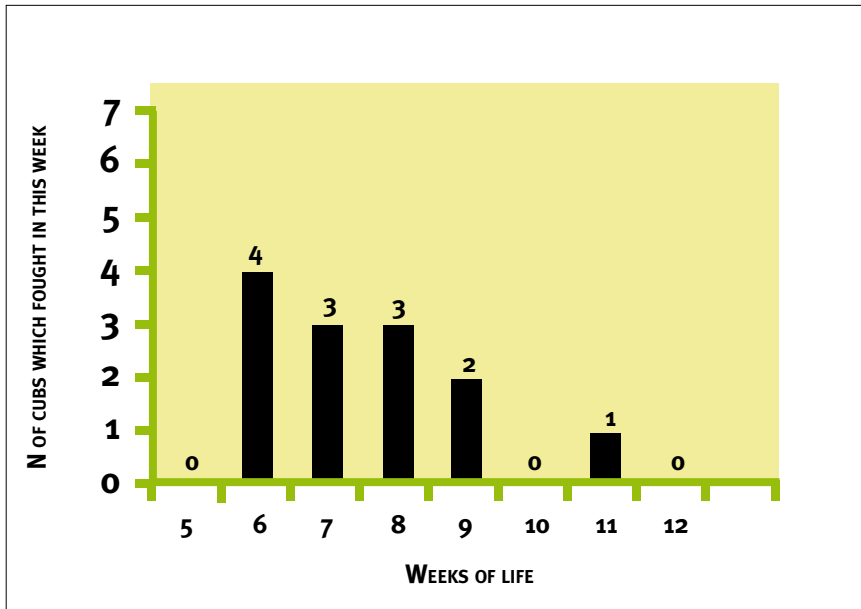


FIGURE 1.
AGE OF AGGRESSOR IN IBERIAN LYNX FIGHT (MOTHER-RAISED AND HAND-RAISED LITTERS). IN 2009, AT THE TIME OF UPDATING THIS DATA, SEVEN NEW FIGHTS HAD TAKEN PLACE: THREE OF THEM DURING THE 6TH WEEK OF LIFE, ONE FIGHT DURING THE 7TH WEEK, TWO MORE DURING THE 8TH POSTNATAL WEEK, AND ONE IN THE 9TH WEEK.

FIGURA 1.
EDAD DEL CACHORRO AGRESOR EN CAMADAS DE LINCE IBÉRICO. (CRIADOS POR SUS MADRES Y CRIADOS AL BIBERÓN). EN 2009, DURANTE LA REVISIÓN DE ESTE CAPÍTULO, HAN TENIDO LUGAR SIETE PELEAS NUEVAS: TRES DE LLAS DURANTE LA SEXTA SEMANA DE VIDA, UNA DURANTE LA SÉPTIMA SEMANA, DOS DURANTE LA OCTAVA SEMANA POSTNATAL Y UNA MÁS DURANTE LA NOVENA.

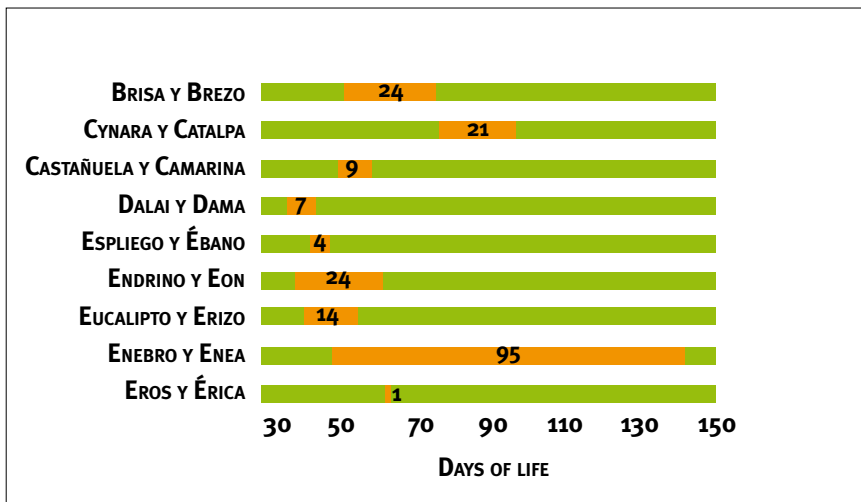


FIGURE 2.
AGE OF FIGHT AND DURATION OF AGGRESSIVE PERIOD IN IBERIAN LYNX LITTERS, NATURAL AND HAND-RAISED. THE END OF THE AGGRESSIVE PERIOD HAS BEEN CALCULATED FROM THE FIRST PEACEFUL REUNION. (ORANGE: AGGRESSIVE PERIOD; GREEN: PEACEFUL PERIOD).

FIGURA 2.
EDAD EN LA QUE LA PELEA TUVO LUGAR Y DURACIÓN DEL PERIODO AGRESIVO EN CAMADAS DE LINCE IBÉRICO, TANTO DE CRIANZA NATURAL COMO ARTIFICIAL. EL FINAL DEL PERIODO AGRESIVO HA SIDO CALCULADO A PARTIR DE LA PRIMERA REUNIÓN PACÍFICA. (NARANJA: PERIODO AGRESIVO; VERDE: PERIODO PACÍFICO).

for only few hours. In one Eurasian lynx litter a new fight emerged nine days after the first one, but the cubs were not aggressive during the period between both fights. Eurasian lynx cubs were separated only on one occasion, after the first fight was observed, and the cubs were checked afterwards for aggressiveness toward littermates. Five days after the fight they were still aggressive, but aggressiveness was not present on the 9th day after the first fight. Iberian lynx cubs were separated by keepers when fighting escalated to a point of concern, and they were later reunited at different time intervals after the fights (4-14 days), once the cubs seemed to have calmed down. Analysis did not reveal a husbandry influence on the duration of aggression between cubs. No correlation was found between time passed from the fight to the first attempt of reunion and the duration of the aggressive period (Spearman rank order correlation: $R=0.52$; $t=1.2$; $n=6$; ns), although this needs to be taken cautiously since sample size is rather small. Duration of after-fight aggression varied across Iberian lynx litters (median=14; min=1; max=95 days) (Figure 2). Thus, the aggressive period in Iberian lynx lasted, in average, until postnatal day 63 (min=45; max=144).

WHO ARE THE AGGRESSORS AND THE VICTIMS?

Eurasian lynx cubs fought with littermates of both the same and opposite sexes. Although females were aggressors in 65% of the fights (m:f=6:11), the sex ratio of aggressors did not differ from the overall sex ratio of all Eurasian lynx litters (Naidenko and Antonevich, this book). In the mother-raised Iberian lynx litters, aggressors were males in 67% cases (m:f=6:2). Sex ratio was equal for mother-raised litters with several cubs (9:9). In hand-raised cubs sex ratio was 6:2 (m:f), taking the bobcat female into account, but all the hand-raised pairs were of the same sex (four male combinations in 2008 and one constant female pair in 2006). Although all pairs had fights, the small sample size does not allow us to analyze the sex ratio of aggressors. Nevertheless, we can state that fights occurred between cubs of the same and of opposite sexes; i.e., males and females were aggressors in different litters. The tendency was that, before the fight, the aggressor in Eurasian lynx litters was larger than the attacked cub, but in general, the neutral cub was usually the largest. Altogether, aggressors were heavier in 71% (10/14) of the cases. Similarly, in mother-raised Iberian litters the aggressor was larger than the victim in 86% of the fights (6/7 litters).



Photo: Anastasia Antonevich

RESPONSE OF MOTHERS TO FIGHTING OFFSPRING

Females tried to stop cub fights as soon as they emerged. Eurasian lynx mothers used their forelegs and mouth to separate cubs in a very rough way. Iberian lynx dams seemed gentler and never used their paws to break a fight. One of the females, *Adelfa*, used her paws to prevent the aggressive cubs from contacting each other, but not to break up a fight between cubs. In both species, females would sometimes use their body to keep cubs apart, licking away the aggressor to move it further from the victim.

CONCLUSIONS

Early sibling aggression in Eurasian and Iberian lynxes occurred during a similar sensitive period and shared many common features, even though husbandry procedures to handle fights greatly differed between the two centers where these studies were carried out. Sibling aggression in other mammalian species tends to emerge during moments of highest competition between sibs, such as nursing, eating, etc. (Drummond, 2006). It has been argued that the lack of resources seems to be the underlying mechanism of litter size restrictions that cause aggression in larger litters (Hofer and East, 2008). Yet, in both lynx species early fights were spontaneous and did not appear to be the result of any direct competition. This characteristic distinguishes lynx fights from early aggression in other taxa (Fraser and Thompson, 1991; Drummond, 2006). The number of attacks per fight was slightly higher for Eurasian lynx encounters than for Iberian lynx ones, but the duration of the aggressive period for the Eurasian lynx was much shorter than for the Iberian species. These differences could be caused by the separation of viciously fighting cubs of the endangered species, so the fight was left unresolved and no behavioral asymmetry was established (Antonevich and Naidenko, 2008). We can also expect species-specific differences to exist in some characteristics of fights like the ways that mothers use to stop cubs from fighting. There is no evidence that sex influences the role of the cub in the fight, but data indicates that size does in both species. Although several characteristics differ between Eurasian and Iberian lynx fights, this phenomenon is similar in both species but differs from sibling aggression in other species of animals.

REFERENCES

- Antonevich, A.L., Naidenko, S.V.**, 2008. Effect of sibling aggression on kitten's behavior in Eurasian lynx *Lynx lynx*. *Acta Zoologica Sinica* 54, 12-19.
- Drummond, H.**, 2006. Dominance in vertebrate broods and litters. *Quarterly Review of Biology*, 81, 3-32.
- Fraser, D., Thompson, B.K.**, 1991. Armed sibling rivalry among suckling piglets. *Behavioral Ecology and Sociobiology* 29, 9-15.
- Hofer, H., East, M.L.**, 2008. Siblicide in Serengeti spotted hyenas: a long-term study of maternal input and cub survival. *Behavioral Ecology and Sociobiology* 62, 341-451.
- Naidenko, S.V., Antonevich, A.L.**, 2009. Sibling aggression in Eurasian Lynx (*Lynx lynx*), in: Vargas, A., Breitenmoser, C., Breitenmoser, U. (Eds.), *Iberian Lynx Ex situ Conservation: An Interdisciplinary Approach*. Fundación Biodiversidad, Madrid, Spain.
- Sokolov, V.E., Naidenko, S.V., Serbenyuk, M.A.**, 1994. Specific fights of young lynxes (*Felis lynx*, Carnivora, Felidae). *Zoologicheskii Zhurnal* 73, 132-138
- Vargas, A., Martínez, F., Bergara, J., Klink, L.E., Rodríguez, J., Rodríguez, D.**, 2005. Update on the Iberian lynx *Ex situ* Conservation Programme. *Cat News* 43, 14-15.
- Vargas, A., Sánchez, I., Martínez, F., Rivas, A., Godoy, J.A., Roldan, E., Simón, M.A., Serra, R., Pérez, M.J., Sliwa, A., Delibes, M., Aymerich, M., Breitenmoser, U.**, 2009. Interdisciplinary Methods in the Iberian lynx (*Lynx pardinus*) Conservation Breeding Programme, in: Vargas, A., Breitenmoser, C., Breitenmoser, U. (Eds.), *Iberian Lynx Ex situ Conservation: An Interdisciplinary Approach*. Fundación Biodiversidad, Madrid, Spain.



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