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## First captive-bred individuals released in the Iberian lynx reintroduction programme

**With only about 350 individuals, the Iberian lynx *Lynx pardinus* continues to be the world's most endangered felid. Ongoing conservation measures include both *in-situ* and *ex-situ* conservation programmes. As part of the first Iberian lynx reintroduction programme, two captive-born individuals were released in the wild in the 2010-2011 season for the first time with this species. The development of both individuals in the wild was good, as they showed natural feeding and social behaviours. Although results are preliminary, this case shows that training protocols designed for this species are working in the right direction.**

The Iberian lynx is listed as Endangered in Spain, and as Critically Endangered (CR C2a(ii)) on the IUCN Red List (IUCN 2008). During the 20<sup>th</sup> Century, its populations suffered a dramatic decrease (Gil-Sánchez & McCain 2011), and by 2003 less than 100 individuals survived in two isolated populations in Andalusia (Southern Spain): Sierras de Andújar-Cardeña and Doñana National Park and surroundings. Given the critical status of the species, a comprehensive Iberian lynx conservation programme was implemented in 2001, including both *in-situ* (wild populations) and *ex-situ* (captive population) conservation actions. The main goals of the *in-situ* programme were to reverse the decline of the wild Iberian lynx populations and to create new nuclei by means of reintroduc-

tion (Simón et al. 2009). *Ex-situ* conservation goals included the establishment of a viable captive population that would help maintain as much as possible of the remaining genetic diversity and provide animals for future reintroduction projects (Vargas et al. 2008). Until 2009, efforts within the *ex-situ* programme were focused on the recruitment of a genetically diverse founder population and in developing adequate captive breeding techniques (Vargas et al. 2009). Between 2002 and 2012, wild populations have grown from 94 to 290 individuals (53-205 in Andújar-Cardeña and 41-85 in Doñana; Simón et al., in press) and the captive population maintains a core breeding nuclei of approximately 60 (30 females, 30 males) adults (plus a variable number of young-of-the-year and subadults). Moreover,

the reintroduction programme has begun releases in two areas within the species' former historic range.

Planning for the first Iberian lynx reintroduction began in 2005 with the selection of the best areas for reintroduction in the Iberian Peninsula based on GIS models. In 2007 and 2008, ground-proofing field surveys were carried out within optimal areas in Andalusia in order to select the best two areas to host Iberian lynx populations. Based on these results, and following the IUCN guidelines for reintroductions (IUCN 1998) two priority areas were selected: Guadalmellato Valley (in Córdoba) and Guarrizas Valley (in Jaén). During 2008 and 2009, as part of LIFE-Nature actions to prepare these two areas for release, emphasis was placed on habitat improvement actions and social awareness campaigns. In addition, two international symposiums took place in order to discuss and elaborate protocols for Iberian lynx reintroduction (Simón et al. 2008, 2010). By late 2009, the initial releases of the first Iberian lynx reintroduction programme took place in Guadalmellato (Simón et al. in press). These releases involved 6 wild individuals translocated from the Andújar-Cardeña population. Concurrently, a protocol for adapting captive-born individuals to the wild was developed. This protocol included (1) a preparation programme for release candidates at the captive breeding centers, and (2) an acclimatization period in 4 ha soft-release enclosures at the reintroduction site. Eighteen Iberian lynx have been released in these two areas between 2009 and 2011 (12 in Guadalmellato and 6 in Guarrizas), and 11 wild-born cubs have already been recorded in Guadalmellato. Two out of the 18 released individuals were the first two captive-bred lynx released into the wild. In this paper we will describe the methodology and post-release performance of the first two captive-bred lynx that were released into the wild. By early 2012, 15 additional captive-bred individuals have been released into both reintroduction areas, and two different release protocols are going to be evaluated. We will not discuss post-release performance of these 15 captive-bred lynx here, since the release process is currently ongoing and there is not sufficient data for analysis.

### Methods

#### *Training for release at the captive breeding centre*

The first management experience with captive-born Iberian lynxes to be released



**Fig. 1.** Naturalized enclosure in La Olivilla captive breeding center (Photo Iberian Lynx *Ex-situ* Conservation Programme).

in the wild took place in “La Olivilla” breeding centre (Jaén, Spain) in 2010. A captive female called Córdoba gave birth to a litter of three cubs: a male – Gitano – and two females – Grazelema and Granadilla –. From birth, these individuals received a long and thorough preparation for adaptation to life in the wild. This specific training included (1) selection of genetically adequate parents, (2) completely naturalized enclosures, and (3) stimulation of natural behaviours (predation, human avoidance and socialization). The selection of parents is focused on maximising genetic diversity in the offspring, with the ultimate purpose of optimising the potential fitness of released individuals (Lacy 1987; Booy et al. 2000). Moreover, the behaviour of mothers was also taken into account (only mothers behaving similarly to wild ones were selected).

Naturalized enclosures (Fig. 1) were large (2,400 m<sup>2</sup>) and included a complex habitat, similar to that found in the wild. In these enclosures, contact between Iberian lynx and keepers was negligible. Given that loss of natural behaviours has been recognized as a threat to the potential adaptation of captive individuals (Jule et al. 2008; Frankham 2008; McPhee 2003), promoting natural behaviours from birth is considered essential for the survival in the wild (Griffin et al. 2000; Hartmann-Furter 2009). To promote natural predatory behaviour, selected lynx were fed 80%-100% wild rabbit *Oryctolagus cuniculus* (Fig. 2), instead of domestic rabbit commonly used in captivity. Other live natural prey such as partridge *Alectoris rufa* were offered occasionally, in the same proportion as they are consumed by free-ranging lynx (Gil-Sánchez et al. 2006). To prevent that reintroduction candidates would link humans with food, we developed a system of automatic feeders connected to a timer. Feeders provided live prey to lynx at random times throughout each 24-hour period. To promote exploratory behaviours, reintroduction candidates were subject to 1-3 day fasting periods. To improve elusive behaviours, lynx-human contacts were avoided and negative stimuli were sometimes conducted through direct persecutions of cubs, shouting and throwing water. Finally, to promote natural social behaviours, human handling during cub’s fighting period (Antonevich et al. 2009) was avoided and social interactions with other lynx were favoured. The training program of “Gitano”, “Grazelema” and “Granadilla” was monitored through a 24hr/day video-surveillance system. Activity rhythms

and behaviour patterns were recorded, which allowed us to evaluate predatory, elusive and social behaviours. Because they were highly rated in all categories, Grazelema and Granadilla were finally selected to be released in the wild (Fig. 3).

*Preparation for release at the on-site acclimatization enclosures*

Grazelema and Granadilla were moved to the Guarrizas reintroduction area (Jaén, Spain) on 4 December 2010. First, a sanitary evaluation was performed to check the health status of both individuals. Once their good condition was verified, they were released in a 4 ha soft-release enclosure together with a wild-caught young-of-the-year male called Granizo. All individuals were radio-tagged with GPS-GSM collars (Microsensory System Division, Fernán Núñez). Performance of the individuals released into the enclosures was monitored through (1) direct observation (8-12 h/day), (2) radio-tracking (6 GPS positions/day) and (3) photo-trapping (three camera-traps motioned by passive infrared lights; Fig. 4). Behavioural data (predatory behaviour, human avoidance and social behaviour) and space use were recorded. In addition to the natural population of wild rabbits held in the enclosures, supplementary feeding was provided during the first stages in the acclimatization enclosures. Throughout the two months that lynx were maintained in the enclosures, this supplementary feeding was progressively decreased from 1 rabbit/lynx every two days to its total suppression. Once the behaviours displayed by Granadilla and Grazelema were categorized as optimal



**Fig. 2.** A three months old Iberian lynx cub, born in captivity, hunting a wild rabbit (Photo José María Pérez de Ayala).

(efficient and effective predatory attitudes, recognition of humans as threats and normal socialization), they were finally released into the wild. On 14 February 2011, a passive release was performed and the four doors of the enclosure were opened. These doors remained opened for the next 10 months, so released individuals could use the enclosure as part of their home ranges. To favour the settlement in the area, supplementary feeding was also provided again inside the enclosure for a 9-month period, 2 rabbits/5 days during the first six months and 2 rabbits/week during the last three months. Post-release monitoring was carried out by means of



**Fig. 3.** Release of Granadilla in the soft-release enclosure in Guarrizas reintroduction area. (Photo Iberian Lynx Ex-situ Conservation Programme).



**Fig. 4.** Granadilla (left), Granizo (center) and Grazelema (right) in the soft-release enclosure. (Photo Iberian Lynx Ex-situ Conservation Programme).

both radio-tracking (6 GPS positions/day and 2 VHF positions/week) and photo-trapping (5 camera-traps).

## Results

### *Preparation at the captive breeding centre*

Out of the three cubs, Grazelema was the most independent and dominant sibling. Moreover, she displayed better hunting attitudes and exploratory movements than Granadilla and Gitano. Granadilla was the most sociable individual, and she was also the most submissive cub. Moreover, Granadilla was very adaptable, and she fitted very well to all the new situations she faced. Gitano was separated from the rest of the litter when he was 5.5 months old, due to high levels of aggressiveness towards his siblings and even towards his mother. He was later discarded for reintroduction because his elusive behaviour decreased.

### *Preparation for release at the on-site acclimatization enclosures*

Grazelema and Granadilla quickly and progressively adapted to the conditions in the on-site pre-release enclosure. Regarding the capacity to hunt, both individuals developed adequate strategies and techniques after their second week in the enclosure. Moreover, cooperative hunting was observed among all three individuals. A progressive decrease in the tolerance to humans was observed during the two months that Grazelema and Granadilla remained in the enclosure. After the second week, they both displayed elusive behaviours similar to those dis-

played by wild individuals. Regarding social behaviours, social relationships (social play, grooming, shared exploratory movements and simultaneous resting in the same sites) were observed among all three individuals. A feeding hierarchy was observed, which was independent from sex. Finally, territorial marking behaviours were detected in the enclosure after the second week.

### *Evolution in the wild*

Once individuals were definitely released, Granadilla and Grazelema behaved normally and problems due to lack of adaptation to wild conditions were not detected in either female. Right after the release, Grazelema made a one-way movement towards the east. From February to early April, she settled in a high-quality area (good habitat and abundant resources) placed 17.5 km SE of the enclosure. On 7 April 2011 Grazelema made a 42 km movement towards the north-east, and she settled in another high-quality area between Andalusia and Castilla-La Mancha (Fig. 5). On 17 August, 2011, after four months living in that area, Grazelema was found dead on private land of Castilla-La Mancha due to a heat shock suffered in an illegal box-trap used for predator control. Although non-selective methods for controlling predators are not allowed in Andalusia, they are allowed in other Spanish regions. Despite this setback, the monitoring data shows that the adaptation of this individual to the wild conditions was optimal. In contrast to her sister, Granadilla has remained in the release area since February 2011 (Fig. 5). The longest movement

she made was a two-way 11 km journey to the NE, which she made just after being released. Granadilla used the supplementary feeding stations for approximately eight months. During the first six months in the wild, Granadilla's home range area was 9,90 km<sup>2</sup>. After that, the home range decreased to 6,95 km<sup>2</sup> (MCP 95 %) due to competition with other wild individuals released in the same area. In early May 2012, reproduction has been detected in Granadilla (at least one cub), as well as in the other adult female (three cubs) living in Guarrizas reintroduction area.

## Discussion

Granadilla and Grazelema adapted well to life in the wild, and the loss of Grazelema was human-caused and cannot be attributed to a lack of development of natural behaviours. Although based on just two cases, these results suggest that training protocols used in these individuals were adequate. After more than 14 months, Granadilla is a territorial female in Guarrizas reintroduction area, recently becoming a breeding female (see Fig. 6). Moreover, the loss of Grazelema shows that non-selective methods for controlling predators are not compatible with the Iberian lynx conservation programme. This experience can be considered as a test of release techniques needed for future Iberian lynx reintroductions, which according to the goals of the new LIFE+-Nature project, they will take place in Portugal, Castilla-La Mancha, Extremadura and Andalusia. To perform these reintroductions, it will be necessary to improve the facilities we are currently using to train individuals. The releases that are currently taking place will give more information about training and protocols.

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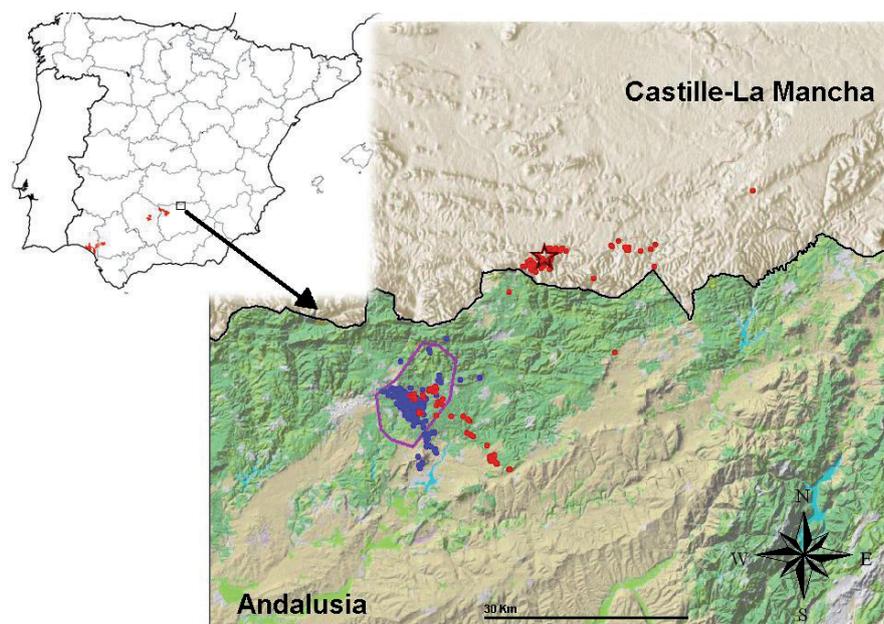
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**Fig. 5.** GPS locations of Grazalema (red dots) and Granadilla (blue dots). Boundaries of Guarzizas Valley reintroduction area are marked in purple. The dark red star marks the approximate place where Grazalema was found dead.

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