# AN ASSESSMENT OF THE EFFECTIVENESS OF WALK-IN TRAPS TO CAPTURE A NEOTROPICAL RAPTOR, THE CHIMANGO CARACARA (*MILVAGO CHIMANGO*), ACROSS DIFFERENT ENVIRONMENTS

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**ABSTRACT**.— Many raptor studies require the capture of individuals and selection of the most effective trapping techniques may be crucial to achieving research goals. We assessed the effectiveness of walk-in traps to capture a very common, but poorly studied Neotropical raptor bird, the Chimango Caracara (*Milvago chimango*) in different environments and we evaluated the effects of environmental and methodological variables on trapping success and number of individuals captured. During 2009–2013 we captured a total of 1452 individuals (188 days and 2178 hours of effective trapping) with at least 423 birds being recaptured at least once during the study. The mean daily capture rate was 0.90 ind/h, with a maximum of 11 ind/h. Number of individuals captured and trapping success were higher during the breeding season and in larger colonies but were lower when longer lapse of non-trapping periods were recorded, then these variables were independent of any other methodological factor and environment type. Trapping success, but not number of individuals captured, increased during the morning when compared with afternoon hours. Trapping success and number of individuals captured were not biased towards any sex, or age group. Our results show that the walk-in trap is a useful and highly effective trapping technique for the Chimango Caracara measured both in terms of number of captures and trapping success throughout the year.

KEY WORDS: *Chimango Caracara,* Milvago chimango*, number of captures, raptors, trapping success, walk-in trap.*

**RESUMEN**. EVALUACIÓN DE LA EFECTIVIDAD DE LAS TRAMPAS DE TIPO "WALK-IN" PARA CAPTURAR UNA RAPAZ NEOTROPICAL, EL CHIMANGO (*MILVAGO CHIMANGO*), EN DIFERENTES AMBIENTES.— En muchos estudios sobre aves rapaces se requiere la captura de los individuos y la selección de la técnica de trampeo más efectiva puede ser crucial para alcanzar los objetivos del estudio. Se evaluó la efectividad de las trampas de tipo "walk-in" para capturar a un ave rapaz neotropical muy común pero pobremente estudiada, el Chimango (*Milvago chimango*), en diferentes ambientes y se evaluaron los efectos de variables ambientales y metodológicas sobre el éxito y el número de individuos capturados. Entre 2009–2013 se capturó un total de 1452 individuos (en 188 días y 2178 horas de trampeo efectivo) con al menos 423 aves recapturadas más de una vez durante el estudio. La tasa promedio de captura diaria fue de 0.90 ind/h, con un máximo de 11 ind/h. El número de individuos capturados y el éxito de captura fueron mayores durante el período reproductivo y en colonias de mayor tamaño, pero fueron más bajos cuando se registraron períodos largos sin trampeo; además, estas variables fueron independientes de cualquier otro factor metodológico o del tipo de ambiente. El éxito, pero no el número de individuos capturados, se incrementó durante la mañana al ser comparado con las horas de la tarde. El éxito y el número de individuos capturados no estuvieron sesgados hacia ningún sexo o grupo etario. Los resultados muestran que las trampas de tipo "walk-in" constituyen una técnica de trampeo útil y altamente efectiva para capturar al Chimango durante todo el año, tanto en términos de éxito como de número de capturas.

PALABRAS CLAVE: *Chimango, éxito de trampeo,* Milvago chimango*, número de capturas, rapaces, trampa tipo "walk-in".*

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Capture and handling are prerequisites of the design and execution of a variety of field studies related to the population ecology of birds. Capture and sampling of individual birds to obtain tissue samples (e.g., feathers, blood) are required for ecotoxicological, physiological, and genetic studies (Goldstein et al. 1999, Sarasola et al. 2004, Hull et al. 2007, Rodríguez et al. 2011, Blas et al. 2013), while trapping and banding of individuals are necessary for studies of population dynamics and long-term population monitoring (Varland et al. 2007, Grande et al. 2009, De Ruyck et al. 2012, Gangoso et al. 2013). More recently, the development of new technologies applied to the study of animal movements, including attachment of devices that allow tracking of animals for habitat use and migration research via telemetry, satellite transmitters and GPS (Global Positioning System) data loggers, has expanded the scope of fields in which capture and tagging of birds is required (Mandel et al. 2008, Strandberg 2008).

Since raptors are a diverse group with a range of habits and behaviours, a variety of capture techniques has been developed based on species-specific behavioural traits (Stewart et al. 1945, Bloom et al. 2007). Among them, the walk-in trap is an easy-to-construct trap that consists of a circular, rectangular or square cage where the bird enters through a funnel-shaped entrance that is difficult to exit. Baited with carrion, walk-in traps are particularly effective at catching raptors that are obligate scavengers, since birds do not need to be immediately removed from the trap once captured and several individuals may be captured simultaneously (Schroeder and Braun 1991, Lindström et al. 2005, Bloom et al. 2007, Barber and Bildstein 2011). Walk-in traps have been also employed to catch Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), and Northern Harrier (*Circus cyaneus*) when baited with a tethered lure bird (Bloom et al. 2007).

Figure 1. An active walk-in trap in a successful trapping session in La Pampa Province, Argentina, with 27 individuals of the Chimango Caracara (*Milvago chimango*) within.

The Chimango Caracara (*Milvago chimango*) is a very common raptor that is found from Peru, Bolivia, and southern Brazil, to the Tierra del Fuego in southern Patagonia (Cabezas and Schlatter 1987, Ferguson-Lees and Christie 2001). This species inhabits a wide range of habitats (e.g., rural, suburban, and urban environments) and exhibits opportunistic and generalist food habits (Biondi et al. 2005, Baladrón et al. 2009, Josens et al. 2013) including facultative scavenging. Across its range, it is usually observed in large numbers at permanent trash deposits near cities. It feeds on carrion in agricultural fields as well as roadkill near roads. Due to its scavenging behaviour, the Chimango Caracara has recently been captured in walk-in traps (Biondi et al. 2010, Sarasola et al. 2011, Solaro and Sarasola en prensa). However, no details on trapping effort, trapping success and trap design have been provided in the literature for this raptor species.

Here we examined the effectiveness of walk-in traps to capture the Chimango Caracara in suburban and agricultural environments of the Pampas Region in central Argentina. We assessed the effects of environmental, methodological and species-specific factors on the trapping success and number of individuals captured.

## METHODS

We used walk-in traps (Fig. 1) to capture individuals of the Chimango Caracara from 2009 to 2013 in four breeding colonies located in suburban and rural habitats in La Pampa province, central Argentina. The rectangular traps were built using a 5 × 5 cm gridded wire mesh measuring 2.8 m long, 1.2 m wide, and 1.2 m high. Although our traps were similar in shape to other walk-in traps that were designed to capture Turkey Vulture (*Cathartes aura*), Black Vulture (*Coragyps atratus*), Whitebacked Vulture (*Gyps africanus*), Cape Vulture (*Gyps coprotheres*), Lappet-faced Vulture (*Torgos tracheliotos*), White-headed Vulture (*Trigonoceps occipitalis*), and Marabou (*Leptoptilos crumenifer*) (Parmalee 1954, Bloom et al. 2007, Bamford et al. 2009, Barber and Bildstein 2011), our traps were redesigned using other measures to adapt to the size of our target species. A 0.6 m length funnel entrance with an opening diameter of 0.3 m that narrowed to 0.2 m was located at one of the short sides of the rectangular box.

The traps were baited with cow carrion, including meat, fat, and bones, and were used at all times of the day throughout all months of the year (except March), covering all seasons. Once activated, traps were visited every 2–3 h and individuals captured during that period were removed from the trap. During the study we quantified the number of trapping sessions performed (i.e., the period between activating a trap and disabling it and removing the bait). We also recorded the total time (in hours) that traps were activated during each trapping session and the total number of individuals captured during each session. Only one trapping session with a single trap was conducted per site. In each trapping session we take note of the number of individuals captured, the duration of the trapping session and each was classified as successful when at least one bird was captured during it. This classification was done irrespective of the total number of birds captured during the session and the duration of the session. Irrespective of the duration of each trapping session and for descriptive purposes, we also calculated the capture rate for each trapping session by dividing the number of individual birds captured by the total time (in hours) in which the trap was active.

We modelled the capture success (i.e., trapping sessions with or without captures) and the number of captures (number of individuals trapped in a trapping session) using Generalized Linear Models. These models were built using a binomial error distribution and logit link function to predict trapping success, and negative binomial error distribution and logarithm link function to predict number of individuals captured. This last distribution was used considering the overdispersion present in the dataset. As the duration of each trapping session was variable, an offset term (time that lasted the session) was added as other linear predictor in all models to predict number of individuals captured. Explanatory variables included in the models for two response variables were environment type (i.e., a two-level categorical factor for suburban and rural habitats), colony size (i.e., a continuous variable representing the mean number of active nests during the study period for each of the colonies where trapping was conducted), and life cycle stage (a two-level categorical factor for trapping sessions conducted during the reproductive, August–March, and non-reproductive, April–July, seasons). We considered the potential cumulative effect of successive days of trapping attempts at the same site on the capture success and number of captures too. In order to control for repeated trapping sessions, we included in the models the number of days of previous trapping without interruption at that site. Periods of continuous trapping lasted from 1 to 11 days, so this last variable took discrete values from 0 (i.e., no trapping attempts made during the previous day) to 10 (i.e., maximum number of days previous to the last day of trapping for the most prolonged trapping period). Finally, and in other model sets, we analyzed the effect of non-trapping lapses over number of individuals captured and trapping success. In those trapping sessions done in isolated days, the response variables were taken as number of individuals captured and trapping success of each trapping session, but in those periods in which there was successive days of trapping attempts, we estimate the mean number of individuals captured and mean trapping success of the successive days of trapping. An explanatory variable included in these models was the non-trapping period (i.e., number of successive days without trapping attempts previous to single or successive days of trapping).

We also used Generalized Linear Models to examine the effect of time of the day (i.e., morning or afternoon) on capture success and the number of captures. For this analysis we used only those trapping sessions for which repeated visits to the trap allowed us to assign captured birds to either morning (06:00–12:00 h) or afternoon (15:00–21:00 h) time periods. Trapping sessions were divided into these time blocks and trapping success and number of captures were calculated separately for the two periods. Finally, we used Generalized Linear Models to test potential biases in the probability of capture of different age and sex groups of the Chimango Caracara. We built models with the proportions of juvenile vs. adult and male vs. female birds as response variables, using logit link function and binomial distribution errors. This analysis was conducted only for a subsample of trapping sessions restricted to the breeding season at the largest of the four colonies studied. For this analysis, temporal effects within the breeding period were considered as a five-level factor corresponding to each of the months during the reproductive season of the species. All statistical tests were performed using R software (R Core Team 2009).

## RESULTS

During the four-year study period we captured a total of 1452 individuals of the Chimango Caracara. This was the result of 188 days of active trapping (2178 h). The overall mean (± SD) daily capture rate was 0.90 ± 1.40 ind/h, with a maximum of 11 ind/h. Considering only those trapping sessions that were successful, this capture rate increased to 1.53 ± 1.36 ind/h. The traps used allowed us the simultaneous capture of more than one individual in 152 (59.37%) trapping sessions. The largest number of individuals trapped in a single session was 32. During the study we had 627 recapture events (i.e., recapture of previously captured and banded birds). For about one-third of these recaptures (211 events) we did not record the band number of the recaptured bird, which prevented us from accurately determining the total number of times those birds were recaptured. However, we recorded the band number and the number of recapture occasions for the remaining 423 recaptures. Thus, this fraction of the population (29%) represents individual birds that were certainly recaptured at least once during the study period, with a maximum of seven recapture events for one individual (Table 1).

Trapping success was not affected by environment type nor by the cumulative number of days of previous continuous trapping. However, trapping success was significantly lower in smaller colonies than in large colonies, during the non-reproductive period than during the reproductive period, and when longer lapse of non-trapping periods were recorded (Table 2). Trapping success was significantly higher in the morning than in the afternoon ($\chi^2$ = 131.4, df = 97, $P$ < 0.05), but time of day did not have a significant effect on number of captures ($\chi^2$ = 101.3, df = 97, $P$ = 0.35).

The number of individuals captured was not affected by environment type nor by the cumulative number of trapping sessions performed during previous days (Table 2). However, the number of individuals captured was significantly higher in the largest breeding colony than in the smaller colonies (Fig. 2), during the reproductive period than in the non-reproductive period (Fig. 3), and significantly smaller when longer lapses of non-trapping periods were recorded (Fig. 4, Table 2).

Table 1. Total number of previously trapped, banded and recaptured individuals of Chimango Caracara (*Milvago chimango*) in the four sampling sites in La Pampa Province, Argentina.

| Recapture occasions | Number |
|---|---|
| 1 | 302 |
| 2 | 62 |
| 3 | 26 |
| 4 | 14 |
| 5 | 7 |
| 6 | 4 |
| 7 | 1 |
| Total | 416 |

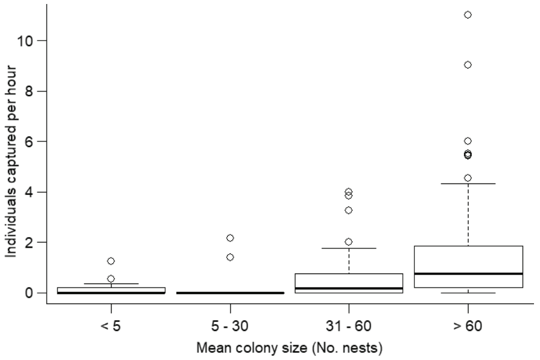


Figure 2. Variation in capture rates of Chimango Caracara (*Milvago chimango*) in colonies differing on their size in La Pampa Province, Argentina.

Table 2. Results of the Generalized Linear Models used to evaluate the relationship between number of captures and trapping success of Chimango Caracara (*Milvago chimango*) using walk-in traps in La Pampa Province, Argentina, and several explanatory variables. Coefficients estimated (± SE), $\chi^2$ values (with df between parentheses), and p-values are shown. Variables that were retained in the minimum adequate model are indicated with an asterisk.

| | Number of individuals captured | | | Trapping success | | |
|---|---|---|---|---|---|---|
| Variable | Coefficient | $\chi^2$ | $P$ | Coefficient | $\chi^2$ | $P$ |
| Environment type (suburban) | -0.183 ± 0.201 | 258.1 (251) | 0.365 | -0.325 ± 0.349 | 260.7 (252) | 0.351 |
| Colony size | 0.035 ± 0.003 | 460.2 (253) | <0.001 * | 0.041 ± 0.006 | 420.6 (253) | <0.001 * |
| Life cycle stage (reproductive) | 2.618 ± 0.249 | inf (253) | 0 * | 2.422 ± 0.380 | 435.7 (253) | <0.001 * |
| Accumulate trapping days | -0.080 ± 0.051 | 279.8 (252) | 0.109 | -0.035 ± 0.086 | 240.2 (251) | 0.6763 |
| Non-trapping periods | -0.006 ± 0.003 | 187.9 (157) | 0.046 * | -0.014 ± 0.005 | 201.0 (157) | 0.010 * |

We did not find evidence of biases in the proportion of male vs. female, or juvenile vs. adults birds captured in relation to the month during the breeding season (sex: $\chi^2 = 27.7$, df = 27, $P = 0.42$; age: $\chi^2 = 38.4$, df = 27, $P = 0.07$), nor in relation to the colony size (sex: $\chi^2 = 33.8$, df = 27, $P = 0.17$; age: $\chi^2 = 33.6$, df = 27, $P = 0.17$).

## DISCUSSION

Most current research on raptors in the field is based on trapping and subsequent marking and sampling of captured individuals. Selection of an effective trapping technique is crucial to such projects, allowing effective data collection and the optimization of research budgets and sampling effort. The walk-in trap is one of the few traps designed to allow simultaneous trapping of several individual raptors (Bloom et al. 2007). This feature, as well as the fact that trapped birds usually do not realize they are trapped and instead continue feeding on carrion in the trap, makes walk-in traps highly effective for social scavengers. In this study we found that walk-in traps were very successful at trapping individuals of the Chimango Caracara, a social species with scavenging habits that is locally abundant through its range (Donázar et al. 1993, Travaini et al. 1995). We were able to trap large numbers of individuals, especially considering the short time period of the study and the restricted range of trapping (i.e., a small number of sites in the same city).

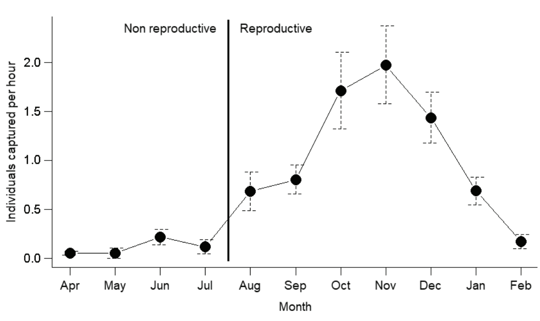


Figure 3. Mean (± SD) capture rates of Chimango Caracara (*Milvago chimango*) through the year and at the two defined life cycle periods (reproductive and non-reproductive) in La Pampa Province, Argentina. No trapping attempts were conducted during March.

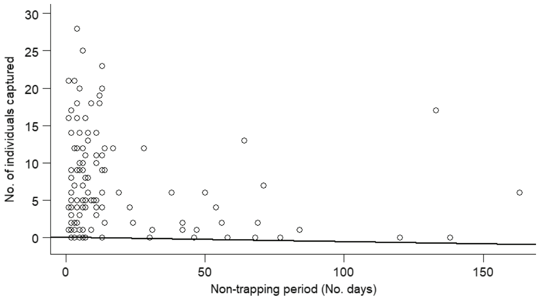


Figure 4. Variation in the captures of Chimango Caracara (*Milvago chimango*) with the number of days that lasted of non-trapping periods in La Pampa Province, Argentina. The line indicates the tendency in the number of individuals captured predicted by the Generalized Linear Model (using the time of each trapping session as offset term in the linear predictor, see *Methods*).

Our assessment on the effectiveness of walk-in traps demonstrates that they are a useful trapping method to capture the Chimango Caracara at any time of year, but particularly during the reproductive period (August–March). Another important factor affecting trapping success and the number of captures was species abundance at each of the trapping sites or colonies. Thus, colony size was the most important variable explaining number of individuals captured and trapping success. Although life cycle stage (reproductive vs. non reproductive seasons) was also significant in all the models, the effect of this variable was in part related to local abundance and colony size. The number of adults that roost at the breeding colony and that remain at the colony site during the non-breeding season would be related to the number of pairs at the colony during the breeding season (Solaro, pers. obs.). Therefore, including life cycle stage in the models allowed us to control for the correlation between local abundance at each trapping site in the non-breeding season and colony size in the breeding season. Our results also showed that walk-in trap effectiveness may be increased if traps are set during the morning, since trapping success (but not number of individuals captured) was higher when conducted early in the day, probably because they are hungrier after the nocturnal fast. For its part, trap effectiveness was independent of the number of trapping trials made on consecutive days at any of the sites sampled. However, trap effectiveness was lower when long periods were left without trapping attempts. Other aspect to highlight in our results is that these traps allow the multiple and simultaneous capture of individuals which would enhance their effectiveness. Although a previous study found that juvenile individuals of the Chimango Caracara are more explorative than adult birds when faced with novel situations (Biondi et al. 2013), and although the design of the walk-in traps required individuals to find the trap entrance, we found no evidence of an age, or sex, bias on trapping success or number of individuals captured.

Employment of walk-in traps also allowed for a high proportion of recaptures (at least 30% of birds in a conservative estimation, but probably more) of previously trapped and marked individuals, with some birds being trapped up to a maximum of six and seven times during the four years of the study period. In a previous work, Solaro and Sarasola (en prensa) have used walk-in traps for the study of the dispersal process of the Chimango Caracara; in this work, trapping with walk-in traps allowed the recapture of 40.7% of birds previously marked. This feature of this particular trapping technique adds further applications and advantages of walk-in traps to the study of birds of prey. Because recapture of marked birds is usually difficult, application of capture–mark–recapture methods to population and demographic studies on raptors are mostly based on band resighting and recovery data (Hiraldo et al. 1996, Grande et al. 2009), rather than on information from recaptures of previously banded, or marked birds. Recapture data may add additional power to capture–resighting databases aiming to estimate demographic parameters, since recaptures may provide additional information (e.g., body and health condition) that may be included in mark–recapture modelling. Furthermore, high recapture frequencies could potentially allow the establishment of studies on different aspects of physiology via re-sampling the same individuals over time.

One disadvantage of walk-in traps is the relative lack of species-specificity. Three species in our study area, the Black Vulture, the Turkey Vulture and the Southern Crested Caracara (*Caracara plancus*), share similar social feeding habits with the Chimango Caracara (Donázar et al. 1993, Travaini et al. 2001). Five Southern Crested Caracara individuals were accidentally trapped on separate trapping occasions. These individuals were trapped simultaneously with the Chimango Caracara in a suburban environment, resulting in the injury or death of six Chimango Caracara individuals in the trap. Therefore, special caution must be taken to avoid simultaneous trapping of different raptor species that may act aggressively towards one another, as well as accidental trapping of ground carnivores (such as cats and dogs in suburban habitats). Traps should be checked periodically, especially during periods of high capture rates such as the breeding season. It is also important to check traps frequently during the breeding season to avoid interfering with reproductive activities (e.g., courtship, nest attendance, and parental care). Our suggestion is that these traps should only be used within approved research projects counting with the opportune permits, and always supervised by expert technicians and researchers.

With these methodological cautions in mind, our results show that walk-in traps are a highly effective trapping technique for the Chimango Caracara, with a broad range of potential applications to different research topics in raptors. We expect that the simplicity and effectiveness of this trapping technique will allow its application to further studies of this little-studied Neotropical raptor.

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