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Ornithological Methods

A simple procedure to reduce investigator-induced chick mortality in Yellow-legged Gull (*Larus michahellis*) colonies

Un procedimiento simple para reducir la mortalidad de pichones inducida por investigadores en colonias de la Gaviota patiamarilla (*Larus michahellis*)

Marc Bosch [1]

ABSTRACT. The most frequently reported negative effect of human disturbance in gull colonies is an increase in chick mortality. This is primarily caused by the presence of humans startling nearby chicks, prompting them to flee out of their own territories where they are attacked by adults of adjacent territories. This effect may be exacerbated in handled chicks. This study proposed and evaluated a simple, non-invasive procedure designed to keep older Yellow-legged Gull (*Larus michahellis*) chicks within their territories after handling and release. The procedure consisted of placing the chicks on the ground in a supine position, with their heads positioned behind their bodies in a way that deprived them of vision. This procedure (vision-deprived supine release) is only appropriate for chicks that are at least three weeks old. Results demonstrated that the procedure significantly increased the time chicks remained at the release site. Moreover, more than half of the sampled chicks did not regain their natural standing posture until enough time had passed for the researcher to have retreated to a distance of approximately 150 m or more, a distance considered sufficient to minimize human disturbance. The only potentially negative aspect of this procedure was that a very small proportion of chicks (n = 1) were not able to roll over and regain their natural standing posture. Although it was uncommon, it should be further investigated. Overall, the vision-deprived supine release may substantially contribute to minimizing investigator-induced disturbance during chick handling in gull colonies.

RESUMEN. El efecto negativo más frecuentemente reportado de la perturbación humana en las colonias de gaviotas, es el aumento en la mortalidad de pichones. Esto es primariamente causado por la presencia de humanos asustando a pichones cercanos, provocando que salgan huyendo de sus propios territorios hacia donde son atacados por adultos de territorios adyacentes. Este efecto puede ser exacerbado en pichones manipulados. Este estudio propuso y evaluó un procedimiento simple, no-invasivo diseñado para mantener a pichones mayores de la Gaviota patiamarilla (*Larus michahellis*) dentro de sus territorios después de manipularlos y liberarlos. El procedimiento consistió en poner a los pichones en el suelo en posición supina, con sus cabezas posicionadas detrás de sus cuerpos de una manera que les privó de visión. Este procedimiento (liberación supina con privación de visión) es solamente apropiado para pichones que tienen por lo menos 3 semanas de edad. Los resultados demostraron que el procedimiento incrementó significativamente el tiempo que los pichones se mantuvieron en el sitio de liberación. Además, más de la mitad de los pichones muestreados no recuperaron su postura natural de pie hasta que hubo pasado el tiempo necesario para que el investigador se retire a una distancia de aproximadamente 150 m o más, una distancia considerada suficiente para minimizar la perturbación humana. El único aspecto potencialmente negativo de este procedimiento fue que una muy pequeña proporción de pichones (n = 1) no pudo darse la vuelta y recuperar su postura natural de pie. Aunque fue poco común, este aspecto debería ser investigado más a fondo. En general, la liberación supina con privación de visión puede contribuir sustancialmente a minimizar la perturbación inducida por el investigador durante la manipulación de pichones en colonias de gaviotas.

Key Words: *chick mortality; handled chick; investigator disturbance; vision-deprived supine release; Yellow-legged Gull*

INTRODUCTION

Many studies have shown that human disturbance can cause several negative effects in waterbird breeding colonies (see a review in Carney and Sydeman 1999). In gull colonies, the most frequently reported negative effect is an increase in chick mortality (Gillett et al. 1975, Fetterolf 1983, Mousseau 1984), which subsequently reduces reproductive success. The underlying cause is that human presence often startles nearby chicks, prompting them to flee out of their own territories where they are attacked by adults of adjacent territories (Gillett et al. 1975, Robert and Ralph 1975, Anderson and Keith 1980, Fetterolf 1983). This effect may be exacerbated in chicks that are handled by humans because they run farther away from the nest within a disturbed colony (Burger 1981). Similarly, Brown and Morris (1995) observed that handling chicks increased the likelihood that these chicks would run after being returned to the nest.

In fact, attacks or predation by adult conspecifics are a major cause of chick mortality and breeding failure in many gull colonies (Kadlec et al. 1969, Parsons 1971, Davis and Dunn 1976, Spaans et al. 1987, Watanuki 1988, Camphuysen and Gronert 2012). In these and other colonies, where minimizing chick mortality is particularly important, human disturbance may constitute an additional threat. Ideally, avoiding a colony (Rodgers and Smith 1995, for Charadriids), restricting human access (Anderson and Keith 1980), or terminating investigator visits after the hatching

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period (Brown and Morris 1995) would provide the most protective measures. However, this would prevent the implementation of numerous studies that could yield valuable information for the management of these colonies and gull species, and research often requires entering colonies during the chick-rearing period to capture and handle chicks.

Within this context, there is a need to develop methodologies that allow researchers to enter gull colonies and handle chicks while simultaneously minimizing investigator-induced mortality. This requires developing procedures that prevent handled chicks from fleeing their territories after release. Some authors have proposed placing chicks under bushes or with their heads in crevices or shelters, allowing them to remain hidden and calm rather than dispersing (Rodgers and Burger 1981, Brown and Morris 1995). However, this technique is only applicable in colonies with bushy or rocky substrates, and its effectiveness may be limited when chicks are already fledglings.

The goal of this research is to propose and evaluate a practical, non-invasive procedure designed to keep older Yellow-legged Gull (*Larus michahellis*) chicks within their territories after handling and release, at least for a sufficient period to allow researchers to move away. This would prevent their movement to other territories and consequently reduce the risk of being attacked and killed by adults from the colony.

METHODS

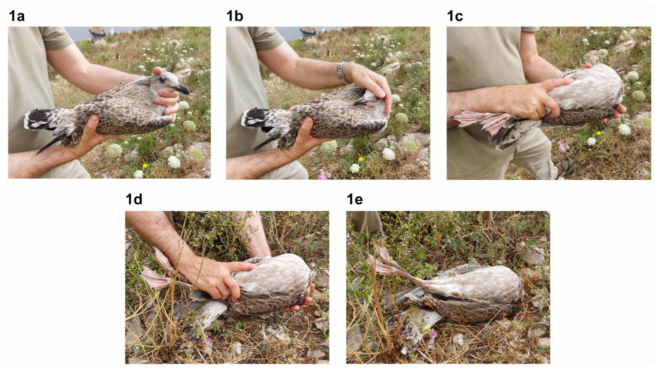
Study area

The Medes Islands (coordinates: 42°02′52.0″N, 3°13′22.0″E), north-eastern Spain, in the western Mediterranean, host a colony of Yellow-legged Gulls that, in the early 1990s, became one of the largest colonies of this species in the world, with nearly 14,000 breeding pairs (Bosch et al. 1994). In years of high breeding density, chick mortality due to attacks by adult gulls reached 46% (Bosch et al. 2000). Over many years, approximately 15,600 fledglings were ringed in the colony (see Bosch et al. 2019), a process that required handling, while making every effort to minimize any risk to their survival.

The proposed procedure consists of placing the chick on the ground in a supine position, with its head positioned behind its body. This technique is only appropriate for chicks that are at least three weeks old, as their neck must be sufficiently developed to allow the head to rest comfortably on their back. Furthermore, the procedure should be done on a flat substrate not obstructed by obstacles that might prevent the chick from turning to either side because this is how they regain their standing position. The detailed sequence of the procedure is as follows:

1. Grasp the chick and hold it so that one hand keeps the wings folded and immobilized while also restraining the legs and holding the chick's head with the other hand (Fig. 1a).
2. The hand holding the head gently rotates the head so that it rests against the chick's back (mantle). At this stage, if the hand covers the chick's eyes, it will help the chick remain calm and immobile (Fig. 1b).
3. While keeping the head pressed against the back, turn the chick over so that it is lying on its back, with its abdomen facing upwards and its back down (Fig. 1c).

Fig. 1. Sequence of the procedure to keep the chick within its territory after handling: (1a) immobilization of the chick's wings and legs with one hand and its head with the other; (1b) turning the head and pressing it against the back, attempting to cover the eyes; (1c) turning the chick onto its back; (1d) and (1e) placing the chick on the ground. For a detailed description, see the text.



4. Carefully place the chick on the ground so that its head remains covered and immobilized by its own body (Figs. 1d and 1e). Ensure that the chick lies flat (not tilted to either side), so that the position is stable and prevents the chick from immediately turning over. Avoid placing the chick on a site with lateral obstacles or on a concave surface that could hinder its ability to roll over and regain a standing posture.

To test the effectiveness of the procedure, the time it took chicks to flee after being released at the capture site was compared under two conditions: without applying the procedure (hereafter, control release) and with the procedure applied (hereafter, vision-deprived supine release), during the period between the fourth week of May and the second week of June 2025. A total of 54 chicks, aged from 23 days to fledging (estimated from body measurements; *unpublished data*), were caught by hand and underwent both types of releases in the following order: first, the control and, after that, the vision-deprived supine release. To ensure that any differences in response times were due to the procedure rather than the order of releases, a subset of 15 individuals was given a third release again without applying the procedure (second control). In all cases, the researcher remained at the release site to maintain consistent conditions throughout the trials. Response times were recorded by assistants also at the release sites.

It was assumed that the minimum escape time was 1 s, although some individuals took less time. Conversely, the maximum observation period for chicks that did not flee was set at 10 min (600 s); if this period elapsed, these chicks were considered to have remained at the release site. An initial analysis identified eight outliers out of 118 escape time values (corresponding to eight chicks) using the interquartile range (IQR) method (Tukey 1977). This method is a robust, non-parametric approach that does not assume data normality and is widely recommended for datasets with small to moderate sample sizes (Hoaglin et al. 1986, Barnett and Lewis 1994). Chicks exhibiting outlier values in any release were excluded from subsequent analyses of escape time, as even a few outliers can sometimes distort group results, especially when the sample size is small (Cousineau and Chartier 2010). Differences in escape time were assessed using paired data tests. Specifically, the Wilcoxon signed-rank test was employed, as the distributions of escape times for the two control releases differed significantly from normality (control: K-S d = 0.299, $p < 0.01$; second control: K-S d = 0.431, $p < 0.05$). Differences in the frequency of chicks that remained in the territory were analyzed using Fisher's exact test because the expected frequencies in the groups of individuals that did not flee were less than five.

The effectiveness of the procedure was also evaluated by comparing the frequencies of chicks that took more than 120 s to leave the release site. Within this time interval, a researcher walking at a moderate-intensity pace (4.3 km/h; Tudor-Locke et al. 2018) can move away from the chick to a distance close to that described by Rodgers and Smith (1995) as sufficient to avoid human disturbance in colonies of various charadriid species, thereby minimizing the likelihood that the chicks will feel the need to flee.

RESULTS

All chicks released in the vision-deprived supine position, except for one individual, were able to right themselves and regain their natural standing posture autonomously within 10 minutes. After this period, the remaining chick, which showed no apparent reason that would have prevented it from righting itself, was assisted by the researcher to achieve a standing position. With the exception of this chick and the few that remained in the territory, all others, once they had regained their natural upright position, fled in the same manner as those released directly (i.e., during the control and second control releases).

The time that chicks remained at the release site before fleeing was significantly longer in the vision-deprived supine release compared to the control and second control releases (see Table 1). The mean time before fleeing in the vision-deprived supine condition was 158.7 s, which is 69 times longer than that observed in the control release (2.3 s) and approximately 113 times longer than in the second control release (1.4 s).

The distribution of the time spent at the release site before fleeing differed depending on the type of release. In the vision-deprived supine release, only four chicks remained at the release site for less than 30 s, while 83.7% of the chicks stayed at the release site for 30 to 360 s (75.9% when including outliers and those that did not flee) (Fig. 2). In contrast, during the control release, 100% of the chicks fled within 1 to 8 s (87% when considering all individuals), and in the second control release, all chicks fled within 1 to 3 s (95.9% when considering the entire subsample).

The frequency of chicks that remained at the release site for 120 s or more was significantly higher in the vision-deprived supine release compared to both the control and the second control releases ($\chi^2_1 = 33.65$, $P < 0.001$, and $\chi^2_1 = 15.64$, $P < 0.001$, respectively). In the vision-deprived supine release, 53.1% of chicks remained for at least 120 s (57.4% when considering the entire sample, that is, including outliers and individuals that did not flee), whereas in the control and second control releases, this percentage was 0% (5.6% and 0% when considering the entire sample and subsample, respectively).

Table 1. Time spent (s) by chicks at the release site before fleeing in the presence of the researcher for each release type. Results of comparison tests are included.

	N[†]	Mean (*s*)	Std. Dev.	Maximum value
Vision-deprived supine	49	158.7	115.4	420
Control	47	2.3	1.7	8
Second control	14	1.4	0.6	3
Comparisons test:				
Vision-deprived supine vs control			N = 45; Z = 5.84; P < 0.0001	
Vision-deprived supine vs second control			N = 13; Z = 3.18; P < 0.002	
Control vs second control			N = 13; Z = -2.90; P < 0.705	

[†]Chicks that did not flee and outlier values are not included.

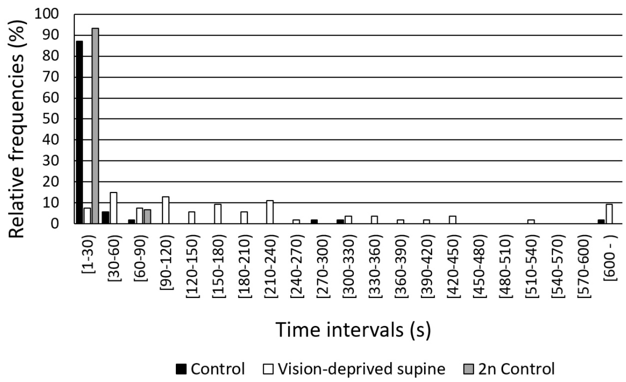
The frequency of chicks that remained at the release site did not differ significantly between the vision-deprived supine release and the other two release types (vision-deprived supine vs control: $P = 0.363$; vision-deprived supine vs second control: $P = 0.570$; control vs second control: $P = 1.00$). In the vision-deprived supine release, three chicks remained in the territory after righting themselves and regaining their natural standing posture; in the control release, only one chick remained, while in the second control release, none did.

DISCUSSION

The results of this study demonstrated that the vision-deprived supine release markedly increased the time chicks remain at the release site. When chicks were released using this procedure, a high percentage (more than half of the sample) did not regain their natural standing posture until enough time had passed for the researcher to have retreated to a distance of approximately 150 m or more. According to Rodgers and Smith (1995), this distance is sufficient to avoid human disturbance in colonies of various charadriid species. As a result, the chicks released using the vision-deprived supine release would no longer feel the urge to flee if the researcher had already moved away. Remote observations of 10 chicks released using this procedure, along with other unsystematic personal observations previous to this study, confirm that chicks tend to remain in their territory if the researcher is at a considerable distance when they regain their natural standing posture. This finding is especially relevant because handled chicks show a greater tendency to flee, and to do so over greater distances when released directly (Burger 1981, Brown and Morris 1995). Because chicks escaping from their territory often leads to mortality by attacks by adult gulls from neighboring territories (Gillett et al. 1975, Robert and Ralph 1975, Anderson and Keith 1980, Fetterolf 1983), reducing the risk of flight also reduces the risk of death. Thus, the vision-deprived supine release effectively reduces the impact of investigator disturbance.

The frequency of chicks released using the vision-deprived supine release that did not flee did not differ significantly from that obtained through direct releases (control and second control). This result is expected because when the chicks recovered their natural standing posture, the researcher was still present (as in the other two releases), and their flight impulse was therefore maintained. It should be noted that a larger sample size would

Fig. 2. Distribution of time spent at the release site by the 54 chicks, according to the type of release. The last interval corresponds to chicks that did not flee.



have been preferable for this comparison (the current one is relatively small) in order to ensure that the absence of detected differences was not due to low statistical power.

The vision-deprived supine release does not appear to cause stress to the chicks; on the contrary, it might have a calming effect. Several authors have demonstrated that visual deprivation (using devices such as hoods, specs, or polypeepers) reduces stress in handled birds including, both poultry and wild species (Arbi et al. 1983, Doss and Mans 2016, Madden and Mitchell 2018, Cococcetta et al. 2023). Moreover, the supine position may facilitate a state of inactivity in handled birds. In poultry, a widely studied technique (induced tonic immobility) is based on placing individuals in a supine or lateral position and holding them immobile for a variable period, with one hand pressing on the sternum (Jones 1986, Gallup and Rager 1996, Heiblum et al. 1998). There is very little literature on this technique in gulls. Montevecchi (1978) applied induced tonic immobility to a sample of 60 chicks divided between Herring Gull (*Larus argentatus*) and Great Black-backed Gull (*Larus marinus*), placing each chick in the supine position on level ground and restraining it with both hands (thumbs on the sternum) for 15 s. In his study, 27% of the chicks remained at the release site for less than 5 s (considered as "no response"); the remaining chicks remained immobile for a longer period, until they got to their feet or 10 min had elapsed, at which point they were handled by the researcher. In contrast, in the present study all chicks exceeded this period of time, with 12 s being the shortest recorded time, and their immobility did not require restraining them with both hands for 15 s; by depriving them of vision, they remained still immediately.

The only potential limitation of the vision-deprived supine release is that a very small proportion of chicks might fail to right themselves, as observed in one case after 10 min and also reported by Montevecchi (1978) for the same time interval. In the reviewed literature on tonic immobility, no references were found indicating that this response in birds can persist indefinitely under natural conditions; nonetheless, it would be valuable to determine whether all chicks eventually recover and, if so, the maximum time required. Furthermore, care should be taken to avoid obstacles or surface features that could hinder chicks from regaining their upright posture.

Carney and Sydeman (1999:77) stated that "more attention needs to be focused on the development of minimally-invasive techniques that permit the collection of accurate data and result in minimal disturbance to the birds being studied." In this respect, some authors have proposed placing chicks under bushes or with their heads in crevices or shelters, encouraging them to remain hidden and calm rather than dispersing (Rodgers and Burger 1981, Brown and Morris 1995). However, based on personal observation, the effectiveness of this technique has proven to be variable in the Yellow-legged Gull colony of the Medes Islands. Furthermore, depending on the area of the colony (e.g., bare soil or grass), it is very often not possible to find rock crevices or bushes where chicks can hide their heads. The vision-deprived supine release described in this article may greatly contribute to minimizing investigator disturbance when handling Yellow-legged Gull chicks, regardless of the substrate where they are captured. It would also be interesting to test the effectiveness of this procedure in other long-necked gull species (such as Herring Gulls, Black-backed Gulls, Western Gulls [*Larus occidentalis*], Glaucous-winged Gulls [*Larus glaucescens*], etc.) in increasing the time chicks remain at the release site and thus reducing the potential impact of investigator disturbance.

CONCLUSION

The procedure presented in this article (vision-deprived supine release) significantly increased the time handled chicks remained at the release site after being released. In more than half of the cases, it allowed enough time for a researcher to move far away while the chick stayed at the release point. This simple procedure may substantially help to minimize investigator-induced disturbance during chick handling.

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Data Availability:

The data and code supporting the findings of this study are openly available in the CORA.RDR repository (http://dataverse.csuc.cat) at https://doi.org/10.34810/data2802.

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