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A funnel trap for the capture of tits

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Baited funnel traps can capture high numbers of birds and generally do not suffer from trap-response biases (e.g. trap-shyness or trap-wiseness). Here we describe a modified funnel trap and test its efficiency. The trap mainly captured tit species, but it also trapped other species such as Nuthatches Sitta europaea, *Robins* Erithacus rubecula, *House Sparrows* Passer domesticus *and Jays* Garrulus glandarius. *The trap captured more than twice as many Great Tits* Parus major *as did baited mist nets. Moreover, it could be used under any meteorological conditions, was very easily set, and produced recapture rates close to 100%. There was significant monthly variation in the mean number of Great Tits captured per half-day and trap, with the highest daily capture rate in July-August and the lowest in November-December. The high capture rate of birds in July-August was due to the presence of juvenile Great Tits (Euring age 3J). The potential biases in the sampling of tit populations by means of funnel traps are reviewed with reference to the relevant literature.*

Key words: Great Tit, *Parus major*, baited funnel trap, trapping efficiency, trapping biases.

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INTRODUCTION

Baited automatic traps are increasingly becoming very popular among ringers and capture-recapture biologists. High numbers of birds can be trapped and removed quickly, and, once constructed, the traps can be set up rapidly and can work independently of adverse weather conditions like wind, snow or rain (Bateman 1979, Davis 1981, McClure 1984). Two main trapping devices may be distinguished. In "trap-yourself" traps, the bird enters lured by the bait and traps itself by releasing the closing mechanism. The main disadvantage of this kind of baited automatic trap is that birds may learn to steal food without activating the mechanism

which closes the trap; as a consequence the mean number of recaptures per season may decrease with increasing age and experience of the birds ("trap-wiseness"; Elder & Zimmerman 1983). Conversely, the funnel trap is a kind of automatic trap that does not suffer from "trap-wiseness" because the birds do not have to release the closing mechanism: the birds simply find an easy way to enter, but they are unable to exit the trap.

The aim of this paper is to test for the the efficiency of a modified baited funnel trap for the capture of tits. The test was carried out by comparing capture rates of Great Tits *Parus major* at baited funnel traps, with those at mist nets associated with baited feeders.

Trap description

The trap is rectangular (30 x 40 x 30 cm), with an extension area of 10 cm at the front of the bottom section which allows for the landing of the birds once the trap is set (see below and Fig. 1). This part of the trap is essential for birds to find the entrance hole once the trap is set. The metal framework is covered on all the sides, except the front, by 1.5 cm mesh wire net. We used that mesh size because it allows a bird to put its head through the hole without injuring its head in trying to escape. However, in some study areas we have had problems with Jays *Garrulus glandarius* capturing and killing the birds through the holes; in those cases a 0.5 cm mesh size is advised. The mesh wire net on the bottom is 0.5 cm, allowing the birds to walk more easily on it. The frontal part of the trap has a 1.5 cm meshed door, that can be raised, allowing the birds freely to use the feeders in the trap (Fig. 1A); or it can be lowered, so that the birds can only enter the trap throught the funnel (Fig. 1D). The funnel (8 x 8 cm) is located in the bottom at the front, leading 20 cm into the trap (Fig. 1D-2, 1C). The end of the funnel is closed but roofless (Fig. 1C-6), so that the birds get into the trap through the small (8x8 cm) hole in funnel roof. Once in the trap, the birds do not find the way out because they attempt to escape by trying to find a gap in the perimeter netting.

When the trap is newly situated in a new area, and birds are not yet familiarized with it, they can have some difficulty in finding the entrance hole. We have designed the trap in the described way because it is easier to construct and once the birds are used to the trap there is no problem in capturing them; however, if one is interested in rapid captures in new areas, we advise the construction of a wider funnel made up of wire netting, which may even be as wide as the whole breadth of the front part of the trap (Fig. 1B-5).

The wire mesh feeder, containing husked peanuts or other tit food, is located on the opposite face from the entrance (Fig 1A-1). The size of the feeder mesh was 4.5 mm, although we added a 0.1 mm mesh on the exterior side, to prevent tits from feeding from the outside of the trap. Similar results can be obtaining using cylindrical feeders made of 4.5 mm wire mesh net containing husked peanuts and hanging from the trap roof in the middle of the trap. The trap also works if it is baited with husked peanuts or sunflower seeds on the trap floor. This latter baiting method has the inconvenience that the birds run out the bait faster because they pick up one peanut or sunflower per trip, whereas with the wire mesh feeders they have to feed on small portions through the mesh.

The trap has a window for removing the birds once trapped (11 x 11 cm), which is at one lateral side of the trap (Fig. 1A-4). A wire mesh of 4 cm can be additionally located at the frontal part of the trap to prevent undesirable birds (e.g. *Garrulus glandarius, Dendrocopos major*) or mammals (e.g. *Sciurus vulgaris*) from entering the trap and feeding on bait or attacking tits.

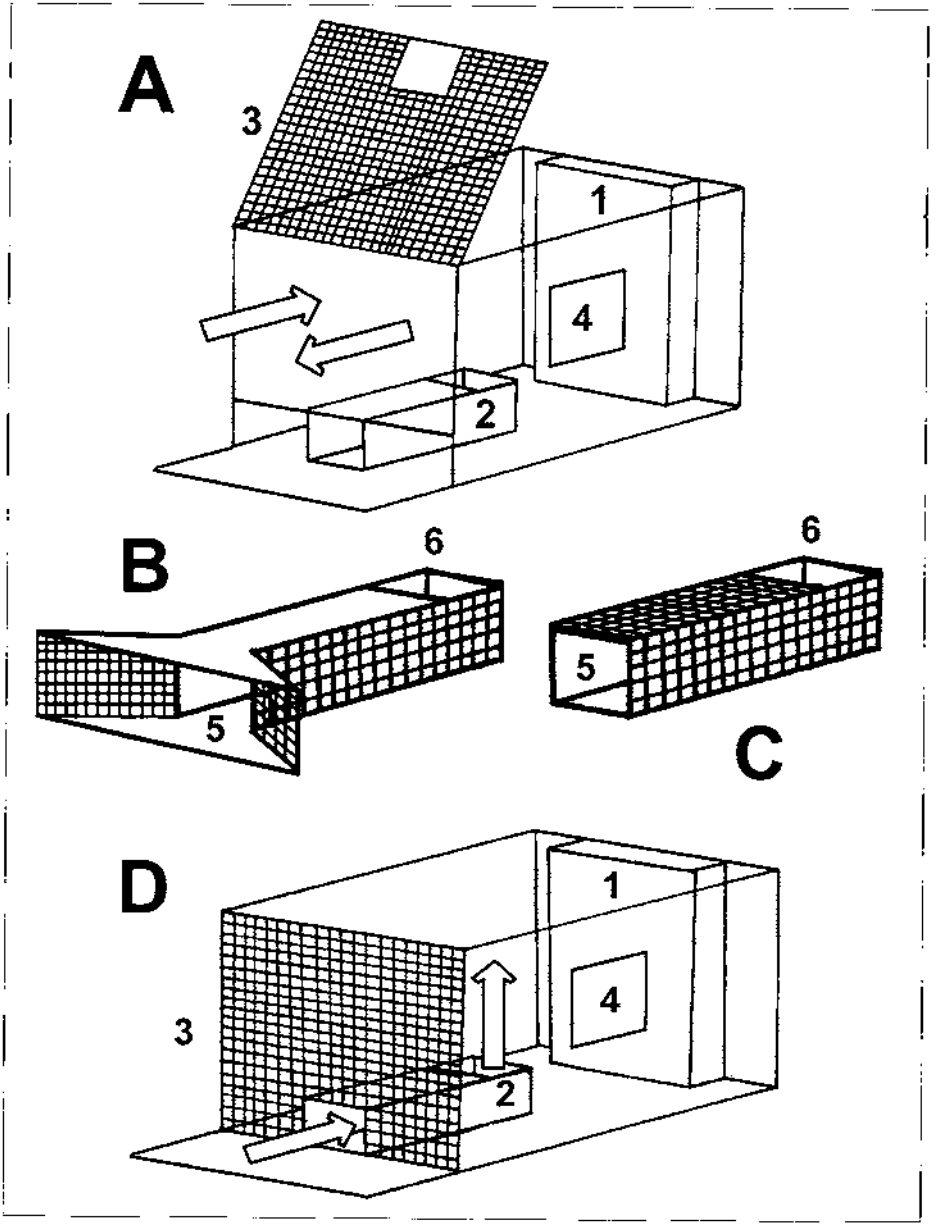

Figure 1. Funnel trap design. A) Lateral view in free access position. B) & C) Funnel (5: access to funnel; 6: access into trap from funnel). D) Lateral view in activated position (1: feeder; 2: funnel; 3: door; 4 door for extracting birds).

Figura 1. Disseny de la trampa túnel: A)Vista lateral en la posició d'accés lliure. B) & C) Túnel (5: accés al túnel; 6: accés a l'interior de la trampa des del túnel). D) Vista lateral en posició de captura (1: menjadora; 2: túnel d'accés; 3: porta mòbil; 4 porta per extreure els ocells).

Study areas and methods

Trapping of Great Tits with funnel traps was carried out from 1994 to 1996 in two areas: Sarrià, an area of 3 ha of orchards and mixed coniferous forest, near Barcelona (NE Spain), and El Ventorrillo, an area of 6 ha of mixed-montane coniferous forest at Sierra de Guadarrama in central Spain (see Carrascal et al. 1998 for more details about both study areas).

The efficiency of the funnel trap in capturing Great Tits was tested at El Ventorrillo by comparing the number of Great Tits captured by four funnel traps with the number caught by three 12m mist nets, each associated with permanent feeders. Two feeders (wooden boxes with one side [20 x 11 cm] covered by a 4.8 mm mesh plastic net that allowed birds access to food) were associated with each mist net. Trapping points were located about 50-75 m from each other. We obtained a total figure of 546 captures of Great Tits scattered during the winters from 1989-90 to 1995-96. Trapping was carried out from dawn to dusk, and so figures on trapping efficiency refer to the number of birds trapped per day (about 9 hours). Trapping seasonality was studied in Sarrià by analysing capture distribution of Great Tits by two-month periods. In this area we obtained a total of 817 captures, using two funnel traps, during the years 1994-1996. Trapping was carried out in five-hour trapping sessions, and so figures on trapping seasonality refer to the number of birds trapped per half-day. The study of trapping seasonality was not possible for the El Ventorrillo data set because in this area the birds were only trapped during the winter.

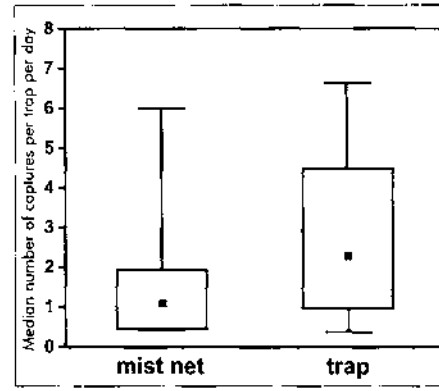

Figure 2. Box-Whisters plot of the number of wintering *Parus major* trapped per day per trap or net in El Ventorrillo, comparing baited mist nets with funnel traps. The small square refers to the median, the box refers to 25-75% limits, and the lines refer to minimum and maximum values.

Figura 2. Figura de Box-Whisters sobre el nombre de Parus major *hivernants capturats per dia i trampa o xarxa a El Ventorrillo, comparant la xarxa japonesa associada a menjadores amb la trampa túnel. El petit quadrat es refereix a la mitjana, el quadrat gros proporciona els límits del 25-75%, i les línies proporcionen els valors màxim i mínim, respectivament.*

Species captured

Tits (*Parus major, P. caeruleus, P. cristatus* and *P. ater*) were the most frequently captured birds. *Sitta europaea* was also trapped very often. We also captured in lower numbers: *Aegithalos caudatus, Passer domesticus, Erithacus rubecula, Sylvia atricapilla, Sylvia melanocephala, Fringilla coelebs, Prunella modularis, Turdus merula, Dendrocopos major* and *Garrulus glandarius*. Within the same habitat a funnel trap can probably capture different species depending on funnel diameter, bait used or trap distance above ground. However tits are particularly easy to catch with this kind of trap due to their strong tendency to explore and the fact that they use natural holes for feeding or nesting (see also Camps et al. 1993).

Trap efficiency

Mann-Whitney tests comparing the number of wintering tits trapped per trap

per day in El Ventorrillo, according to trapping method, showed that funnel traps captured more than twice as many Great Tits as did baited mist nets (Mann-Whitney U Test; U=432,5, d.f.=1, P<0.01) (Fig. 2).

Trapping seasonality

The funnel trap in Barcelona showed significant monthly variation in the mean number of Great Tits captured per half-day, with the highest daily capture rate in July-August and the lowest in November-December (Kruskal wallis ANOVA combining all ages; H=19.89, d.f.=5, P<0.01). The high capture rate of birds in July-August was due to the presence of juvenile Great Tits (Euring age 3J), which were captured disproportionately in that period (Fig. 3, Kruskal wallis ANOVA for juveniles; H=13.57, d.f.=2, P<0.01). Adult-plumaged birds (Euring ages 3-6), on the contrary, follow a reversed pattern (Fig. 3; Kruskal wallis ANOVA for adult-plumaged birds; H=28.20, d.f.=5, P<0.001).

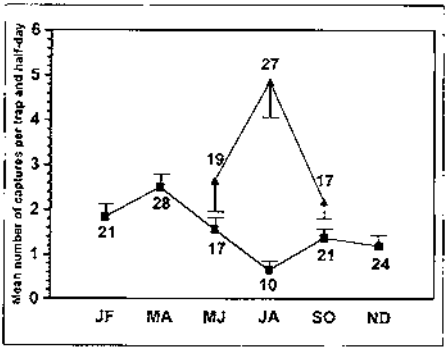

Figure 3. Variation in the mean number (± s.e.) of *Parus major* trapped per half-day (5 hours) per trap throughout the year by two month periods in Barcelona. ▲) Juveniles (Euring age 3J); ■) Birds in post-juvenile plumage (Euring ages 3-6). N = half-day trapping sessions.

Figura 3. Variació en el nombre mitjà (± s.e.) de Parus major *capturats per mig dia (5 hores) i trampa al llarg de l'any, en períodes de dos mesos, a Barcelona. ▲) Juvenils (edat Euring 3J); ■) ocells en plomatge postjuvenil (edat Euring 3-6) (± d.e.). N = sessions de trampeig de mig dia.*

Trap biases

Trapping methods can produce biases in the sampling of studied populations (e.g. Chao 1987, Reinecke & Shaiffer 1988, Pollock et al.1990) and may lead to unreliable inferences (e.g. Weatherhead & Greenwood 1981, Weatherhead & Ankney 1984, Chao 1987). It is therefore necessary to know the nature of these biases, and to bear them in mind.

There are two main kinds of bias: 1) behavioural response to the trap, in which the probability of capture of a bird depends on the animal's prior history of capture (trap-happiness, trap-shyness); and 2) heterogeneity, in which the probability of capture of a bird is a property of the animal and may vary among the animals in the population due, for example, to sex or age.

No trap response was detected in any of the different age or sex classes (Senar et al. *in press;* a). This is probably be due to the fact that in our study areas artificial food had a very low impact on the energy budget of Great Tits (see Carrascal et al. 1998) to induce any trap- happiness response.

However, some heterogeneity problems were detected. For instance, adult females were less often captured in the traps than the other age and sex classes, probably because of the lower dependence on supplementary food by that class (Senar et al. *in press;* a).

We have also shown that since funnel traps allow for the capture of several birds at the same time, it can suffer a bias due to a decoy effect: juvenile Great Tits, which are both less experienced and with a lower body condition than adult-plumaged

individuals, were more easily trapped in this kind of trap (Senar et al. *in press;* b).

Concluding remarks

Baited funnel traps have a higher efficiency in the capture of tits than mist nets associated with feeders. Moreover, these traps have other advantages in relation to mist nets: 1) once constructed, they can be set up rapidly; 2) they can work independently from the weather conditions; 3) trapped birds can be removed easily; 4) traps do not need to be visited so often as mist nets; and 5) using an additional wire mesh at the frontal part of the trap and selecting an adequate bait and funnel diameter, it is possible to reduce greatly the number of birds of species not under study that consume both bait and the time needed for removing them from the trap. All of this suggests that the efficiency of the trap could be even greater. The greater efficiency of funnel traps is probably due to the trap-shyness bias suffered by mist nets (Greig-Smith 1980, Schmidt et al. 1986, Wooller 1986, Bauchau & Noordwijk 1995, Dorsch 1998). This bias does not appear in funnel traps (Senar et al. *in press;* a), probably because a bird willing to feed on bait can avoid a mist-net, but in relation to traps it is almost impossible for a bird to take bait unless it goes into them (Domènech & Senar 1997). Moreover, when traps are opened they can work as supplementary feeders to attract birds and to get the birds used to the trapping structure. This produces a very high number of recaptures, in some periods close to 100%. Some birds may even be retrapped twice or more often within the same trapping session. This is clearly not the case of mist nets, which are avoided by Great Tits, once they are used to them (Schmidt et al. 1986).

Trap size can probably affect trapping efficiency, with bigger traps capturing more birds, especially when recently set (T. Borras & J. Cabrera pers. com., comparing the standard described trap with one of 100 x 50 x 50 cm). The maximum number of Great Tits captured simultaneously with our standard trap was six, and a figure of three or four is very common in good periods. However, in our experience, with a trap of 80 x 60 x 60 cm we have been able to trap eight Great Tits at once, and normal figures are more than twice as many birds as in the standard trap. This may be due to less interference between the birds entering the trap and those already captured, and to some trap-shyness by birds not yet familiarized with the trap, since the birds may be less worried to enter a more spacious wire box (see Senar 1988). We normally visit traps every two hours. A higher visiting rate, however, probably increases the total number of captures. Familiarization with the traps can also explain the time delay we have recorded of 2-3 months in the use of funnel traps located in a new area. The fact that new traps located in an area where other funnel traps have been settled for months can be operative in a few days supports this view.

A potential problem with baited funnel traps is related to the differential use of feeders by the different age and sex classes (population heterogeneity), but this problem is caused by the use of bait and is not directly related to one or another kind of trapping device (Senar et al. *in press;* a).•

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RESUM

Una trampa túnel per capturar Mallerengues

Las trampes túnel associades a menjar poden capturar molts ocells i generalment no pateixen biaixos deguts a una possible resposta a la trampa per part dels ocells (e.g. trap-shyness or trap-wiseness). En aquest article descrivim i testem l'eficiència d'una trampa túnel. La trampa de malla metàl·lica té una porta a la part frontal que quan és elevada permet utilitzar la menjadora interior lliurement (Fig. 1A). Quan aquesta porta està tancada (Fig. 1D) permet que els ocells entrin a la trampa pel túnel (fig. 1C), però després no són capaços de trobar la sortida. Aquest mètode captura majoritàriament mallerengues, però també captura altres espècies com el Pica-soques Blau Sitta europaea, *Pit-roig* Erithacus rubecula, *Pardal comú* Passer domesticus o *Gaig* Garrulus glandarius. *La trampa capturava més del doble de Mallerengues Carboneres* Parus major *que utilitzant xarxes japoneses associades a una menjadora (Fig. 2). A més, pot ser usada sota condicions meteorològiques adverses, és molt fàcil col·locar-la en posició de captura, i permet obtenir una taxa molt alta de recaptura, en alguns períodes propera al 100%. La trampa presentava una variació mensual significativa en la mitjana del nombre de Mallerengues Carboneres capturades per dia i per trampa, amb la taxa de captures diàries més alta al juliol-agost i el mínim al novembre-desembre (Fig. 3). L'alta taxa de captura d'ocells al juliol-agost era, però, deguda als juvenils (edat Euring 3J) (Fig. 3). El biaixos potencials que l'ús d'aquestes trampes poden generar en el mostreig de poblacions de mallerengues són revisats d'acord amb la literatura. En general, les mallerengues no eviten ser capturades amb la trampa ("trap-shyness") ni mostren una tendència a ser cada cop més capturades ("trap-happiness"). La trampa presenta, però, problemes d'heterogeneïtat; les femelles adultes, en utilitzar poc les menjadores, són capturades en menor grau que els individus d'altres sexes i edats. Aquest biaix, però, també apareix en altres mètodes de trampeig associats a menjadores. Els individus juvenils, per un efecte reclam, són capturats amb major freqüència que altres classes d'edat.*

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