

Nest-Box use by the Barn Owl *Tyto alba* in a Biological Pest Control Program in the Beit She'an Valley, Israel

Authors: Meyrom, Kobi, Motro, Yoav, Leshem, Yossi, Aviel, Shaul, Izhaki, Ido, et al.

Source: *Ardea*, 97(4) : 463-467

Published By: Netherlands Ornithologists' Union

URL: <https://doi.org/10.5253/078.097.0410>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Nest-box use by the Barn Owl *Tyto alba* in a biological pest control program in the Beit She'an valley, Israel

Kobi Meyrom^{1,6}, Yoav Motro², Yossi Leshem³, Shaul Aviel⁴, Ido Izhaki⁵,
Francis Argyle¹ & Motti Charter^{3,*}



Meyrom K., Motro Y., Leshem Y., Aviel S., Izhaki I., Argyle F., Charter M. 2009. Nest-box use by the Barn Owl *Tyto alba* in a biological pest control program in the Beit She'an valley, Israel. In: Johnson D.H., Van Nieuwenhuysse D. & Duncan J.R. (eds) Proc. Fourth World Owl Conf. Oct–Nov 2007, Groningen, The Netherlands. *Ardea* 97(4): 463–467.

Starting in 1983, nest boxes for Barn Owls *Tyto alba* were erected as part of a biological pest control program to deal with rodents, in Kibbutz Sde Eliyahu, and later in other agricultural fields and plantations in the Beit She'an valley, Israel. More than a decade ago, the nest box scheme was extended to include other agricultural areas in the valley, and grew from 14 boxes on 3 km² in 1983 to about 300 boxes on 90 km² throughout the entire Beit She'an valley in 2007. Here we present the results of a study during the 2002 through 2006 breeding seasons, in which 156 to 243 nest boxes were monitored each season. Mean occupation of nest boxes during the study was 53.5% (SE 2.1, $n = 248$), and a total of 596 breeding attempts were recorded, of which 85.2% successfully fledged at least one young. Yearly occupation of nest boxes varied significantly between the years, ranging from 48.1% to 73.5%. The occupancy rate of first-year nest boxes was lower than that of those available for two or more years. The occupancy rate and the number of nestlings per box (per year) were positively correlated to the distance to the closest nest box and negatively correlated to the number of nest boxes within a 500 m radius. Similar to other studies in the world, the erection of nest boxes for Barn Owls in agricultural fields proved extremely successful in the Beit She'an valley, with 86.7% ($n = 248$) of nest boxes being occupied at least once during the five-year study period. This high occupancy rate demonstrates not only that natural nesting sites were lacking, but also that nest boxes can be used to increase Barn Owl populations in agricultural areas, both for conservation and for biological pest control.

Key words: Barn Owl, *Tyto alba*, nest boxes, occupancy, agriculture, biological pest control, Israel

¹Israel Ornithology Center, Society for the Protection of Nature in Israel, 2 Hanegev St., Tel-Aviv 66186, Israel; ²Department of Evolution, Systematics and Ecology, The Hebrew University of Jerusalem, Jerusalem 91904, Israel; ³Zoology Department, Tel-Aviv University, Ramat-Aviv, 69978, Israel; ⁴Kibbutz Sde Eliyahu, Jordan Valley Mobile Post 10810; ⁵Department of Biology, University of Haifa at Oranim, Kiryat Tivon 36006, Israel; ⁶Present address: Kibbutz Nir David, Bet Shean Valley, Israel; *corresponding author (charterm@post.tau.ac.il)

INTRODUCTION

The Barn Owl *Tyto alba* is one of the most widespread owls in the world (Burton 1984), but information on its breeding success in the Middle East is lacking. Barn Owls are secondary cavity nesters but also breed in a

wide variety of natural cavities such as holes in trees (Taylor 1994), and in man-made nest sites such as buildings and nest boxes (de Bruijn 1984, Petty *et al.* 1994, Taylor 1994). Nest boxes are used by researchers and conservationists as a popular management tool to increase nest site availability in sites where these are

lacking. Furthermore, nest boxes can be easily designed to attract specific species to breed in designated locations, and are easily accessible, which allows capture of relevant species during the non-breeding seasons (Newton 1998). In areas where natural nest sites are limited, certain raptor populations nest almost exclusively in such nest boxes (Cavé 1968, Hakkarainen & Korpimäki 1996), whereas in other locations, although natural nest sites are present, the nest boxes are used because they are preferred (Petty *et al.* 1994). In many places in the world nest boxes are used as a conservation tool to increase populations in areas where natural nest sites are limited (Petty *et al.* 1994), and also in biological pest control projects (Duckett 1976, Hafidzi *et al.* 1999, Hafidzi *et al.* 2003), which promotes reduced use of pesticides (mainly rodenticides) and increased public awareness of owls.

Beginning in 1983, nest boxes for Barn Owls were erected first at Kibbutz Sde Eliyahu and later in other locations in agricultural fields and plantations in the Beit She'an valley, Israel, as part of a biological pest control program to deal with rodents (Aviel *et al.* 2003). More than a decade ago, the installation of the nest boxes was extended to include other agricultural fields in the Beit She'an valley, and increased from 14 boxes on 3 km² in Sde Eliyahu in 1983 to about 300 boxes on 90 km² throughout the entire Beit She'an valley in 2007. In the past, the major part of the project was applied with little scientific background, little analysis of the breeding data, and reference to only a few scientific publications (Tores *et al.* 2005). Barn Owls are one of the most common owls in Israel (Shirihai 1996) but little information has been published on them other than on their diet (Dor 1982, Pokines & Peterhans 1997, Yom-Tov & Wool 1997, Tores & Yom-Tov 2003, Tores *et al.* 2005, Charter *et al.* 2007, Motro unpubl. data), and very few data are available on their breeding success (Kahila, unpubl. data). The main objectives of this study were to characterize the use of nest boxes by Barn Owls breeding in the Beit She'an valley, Israel, as part of a biological pest control program to deal with rodents.

METHODS

The study site comprised agricultural fields, orchards, and plantations located in the Beit She'an valley, Israel (32°30'N, 35°30'E), 150–250 m below sea level. The climate is arid with maximum and minimum mean daily temperatures (during March and July 1999) of 32.3°C and 16.7°C, respectively, and average yearly rainfall of 267 mm (for 2001–06).

The study site is divided mainly into crop fields and date plantations (combined area 90 km²). The crop fields comprise cattle fodder (wheat, sweet corn, alfalfa, clover, vetch and oats), grain crops and seeds (wheat and sweet corn) and spices and herbs (oregano, hyssop, basil, and dill). During the study 156–243 nest boxes (50 cm wide × 75 cm long × 50 cm high; entrance 25 cm high × 15 cm, raised 2.5 to 3 m above the ground) located in the fields and date palm plantations were monitored yearly. The nest boxes were erected between 1983 and 2005 in Kibbutz Tirat Tsvi, Kibbutz Maoz Haim, Kibbutz Kfar Ruppim, Kibbutz Neve Eitan, Kibbutz Ein Hanatziv, and Kibbutz Sde Eliyahu. The project was led by the Israel Ornithological Center, Society for the Protection of Nature, Israel, during 2002–04 and by Tel Aviv University and the Society for the Protection of Nature during 2005–06.

Active nests were determined by visits during the 2002 to 2006 breeding seasons for each breeding attempt (defined as a nest in which eggs were laid, after Steenhof 1987). All nestlings and some of the adults found inside the nest boxes were banded. Mean occupancy rate of nest boxes was noted (number of breeding attempts/number of years the nest box was available during the period of study); as was the percentage of breeding pairs that successfully fledged at least one young; and the mean number of young (number of young per breeding attempts/number of years the nest box was available during the period of study minus the number of dead birds found in the nest boxes after the young had fledged). Similar to breeding Barn Owls in the USA (Taylor 1994), Israel Barn Owls are very sensitive during incubation and abandon clutches when disturbed, so the clutch size of most pairs was unknown and is not presented here. Distances between nest boxes and number of nest boxes within a 500 m radius were calculated using ESRI ArcMap 9.2. Data are presented as means ± SE. All statistical tests were two-tailed and all tests were non-parametric. Descriptive breeding data were analyzed using Kruskal–Wallis ANOVA and Spearman correlations to analyze correlations. Chi-square tests were used for comparing nest success. Levels of significance were set at $P < 0.05$. Statistical analyses were performed using Statistica 7.1 software.

RESULTS

Mean percentage of nest boxes occupied was 53.5% ± 2.1 ($n = 248$), during which time 596 breeding attempts were recorded, of which 85.2% successfully

fledged at least one young. Yearly occupation of nest boxes was significantly different between years ($\chi^2 = 35.0$, $df = 4$, $P < 0.001$), ranging from 48.1% ($n = 243$) to 73.5% ($n = 215$) (Table 1). The percentage of first-year nest boxes occupied was lower than that of older boxes ($\chi^2 = 20.8$, $df = 4$, $P < 0.001$). During the study, 86.7% of nest boxes were occupied at least once and only 13.3% were never occupied. The average number of nestlings per breeding attempt per nest box was 3.7 ± 1.5 ($n = 211$).

The mean distance between boxes was 182.8 ± 7.5 ($n = 220$), and the mean number of nest boxes in a 500 m radius was 6.33 ± 0.3 ($n = 220$). The distance of the closest nest box was positively correlated with both the percentage of nest boxes occupied ($r_s = 0.22$, $n = 213$, $P < 0.01$; Fig. 1A), and the number of nestlings per box ($r_s = 0.17$, $n = 190$, $P < 0.05$; Fig. 1B). The number of nest boxes within a 500 m radius per nest box was correlated with both the percentage of nest boxes occupied ($r_s = -0.17$, $n = 220$, $P < 0.05$; Fig. 1C) and the number of nestlings per nest box ($r_s = -0.17$, $n = 198$, $P < 0.05$; Fig 1D).

Table 1. Breeding parameters of Barn Owls breeding in nest boxes located in the Beit She'an valley, Israel, during the 2002–06 breeding seasons. Sample sizes are in parentheses.

	2002	2003	2004	2005	2006
Percentage of nest boxes occupied	56.4% (156)	60.1% (188)	73.5% (215)	51.7% (232)	48.1% (243)
Percentage of successful pairs	76.1 (88)	85.8% (113)	89.9% (158)	81.7% (120)	88.9% (117)
Number of young fledged per breeding attempt \pm SE	3.3 ± 0.3 (86)	3.8 ± 0.2 (111)	4.7 ± 0.2 (155)	2.7 ± 0.2 (119)	3.9 ± 0.2 (115)

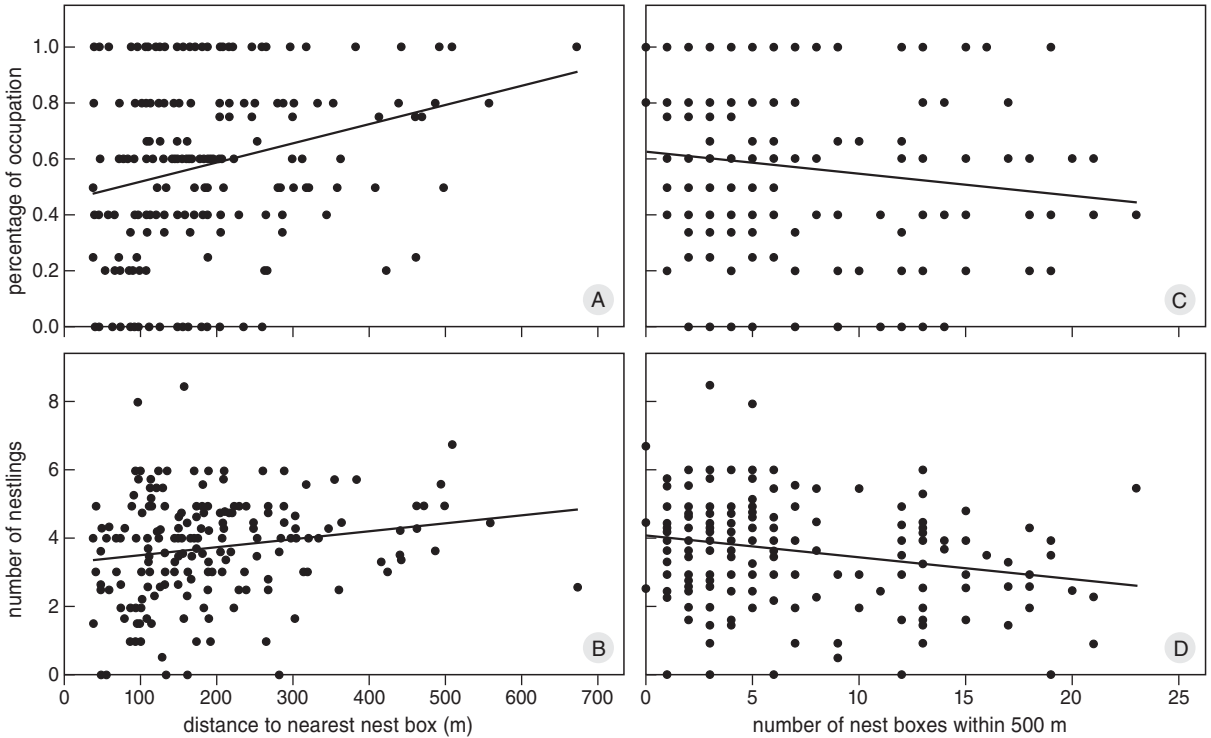


Figure 1. A-D. Correlations between breeding parameters (percentage of nest boxes occupied and number of nestlings) to the distance from the nearest nest box and the number of nest boxes within a 500-m radius.

DISCUSSION

Similar to other studies in the world (Marti 1994, Taylor 1994, Petty *et al.* 1994), the erection of nest boxes for Barn Owls in the Beit She'an valley proved extremely successful, with 86.7% of the 248 nest boxes being occupied at least once during the five-year study. The occupancy of first year boxes was lower than in the following years but, interestingly, no differences occurred thereafter. Barn Owl nest boxes have been used in the region since 1983 and, unlike new regions to the project in Israel, where the rate of occupation of nest boxes is lower (Charter, unpubl. data), the high rate of occupancy reported in the second and following years have been an artifact of the large population of Barn Owls already present in the valley, and the length of the project.

In addition to nest boxes, Barn Owls also breed in the surveyed villages in man-made structures (Meyrom *et al.* 2008) and in Mexican Fan Palms *Washingtonia robusta*. Meyrom (unpubl. data) estimated 50 such pairs yearly, while in the fields themselves few to no nest sites are available. Even though Barn Owls breed anyway in the nest boxes, the particularly high nest box occupancy reported in this study is most likely due to a lack of nest sites in the valley.

The number of young per nest was found to be within the range of other studies (range 1.9–4.6 nestlings) in Europe (Pikula *et al.* 1984, Baudvin 1986, Muller 1989, Taylor 1994, Martínez & López 1999), USA (Otteni *et al.* 1972, Klaas *et al.* 1978, Marti & Wagner 1985, Marti 1994), Asia (Lenton 1984) and Africa (Wilson *et al.* 1984). The high occupancy of nest boxes in 2004 was probably due to a high abundance of Levant Voles *Microtus socialis guentheri*, which peaked during that year in the study sites as well as in some other agricultural regions in Israel (Aviel pers. comm.). No rodent trapping took place during the study, but Motro (pers. comm.) counted vole burrows during the study and found more burrows during 2004 than in other years (in some areas almost 10 000 burrows/ha). The percentage of nest boxes occupied and the number of nestlings per box were positively correlated to the distance of the closest nest box and negatively correlated to the number of nest boxes within a 500 m radius per nest box, possibly due to intraspecific competition and first-year Barn Owls breeding in crowded areas. However, these two latter hypotheses require experimental verification.

Examination of pellets from the region revealed that 90% of the Barn Owls diet is composed of rodents from agricultural fields and plantations (Tores *et al.* 2005,

Charter *et al.* 2007). The presence of Barn Owls is thus welcomed by farmers. Since the establishment of the pest control project, many farmers use Barn Owls as an alternative method of rodent control and thereby drastically reduce the use of rodenticides. The high occupancy of nest boxes by Barn Owls detailed in this study demonstrates, as also found in other studies throughout the world, that not only were natural nest sites lacking in the area, but also that nest boxes offer Barn Owls alternative nest sites, that can increase owl numbers in agricultural fields both for conservation and biological pest control projects. Further studies are needed to compare between the use of Barn Owls and of pesticides in order to determine whether these result in economic differences in crop yield.

ACKNOWLEDGEMENTS

To David Glasner, Eitan Shapira, Uria Shahak, and Moshe Nachtomi for promoting nest box placement in valley. To Ena Olze, Ben Davir, Manor Gor, Roi Ben-Yossef, Yehezkel Giladi, for their assistance in checking nest boxes and Michael Hyman for weather data,. Special thanks to Desh Institute (SPNI's Open Landscape Institute) for their assistance with using GIS and Naomi Paz for editorial help. Thanks to David H. Johnson and Alan Sieradzki for comments on the text. The project was led by the Israel Ornithological Center (special thanks to Dan Alon) of the Society for the Protection of Nature, Israel, and funded by the European Commission during 2002–2004 and led and funded by the Tel Aviv University, The Hebrew University of Jerusalem, and Society for the Protection of Nature, Israel during 2005 to 2006.

REFERENCES

- Aviel S., Motro Y., Kahila Bar-Gal G. & Leshem Y. 2003. The Barn Owl as a biological pest control of rodents. Billet Studios Press, Tel Aviv. (In Hebrew)
- Baudvin H. 1986. La reproduction de la Chouette Effraie, *Tyto alba*. Le Jean le-Blanc 25: 1–125.
- Cavé A.J. 1968. The breeding of the kestrel (*Falco tinnunculus*) in the reclaimed area Oostelijk Flevoland. Neth. J. Zool. 18: 313–407.
- Charter M., Izhaki I., Shapira L. & Leshem Y. 2007. Diets of Urban Breeding Barn Owls, *Tyto alba* in Tel Aviv, Israel. Wilson J. Ornithol. 119: 484–485.
- de Bruijn O. 1994. Population ecology and conservation of the Barn Owl *Tyto alba* in farmland habitats in Liemers and Achterhoek (The Netherlands). Ardea 82: 1–109.
- Dor M. 1982. The Barn Owl—An aid to science. Torgos 2: 29–35.
- Duckett J.E. 1976. Owls as major predators of rats in oil palm estates with particular reference to Barn Owl (*Tyto alba*). Planters, Kuala Lumpur 52: 4–15.

- Hafidzi M.N. & Mohd N. 2003. The use of the Barn Owl, *Tyto alba*, to suppress rat damage in rice fields in Malaysia. In: Singleton G.R., Hinds L.A., Krebs C.J. & Spratt D.M. (eds) Rats, mice and people: Rodent biology and management. ACIAR Monograph No. 96, pp. 274–276.
- Hafidzi M.N., Zulkifli A. & Kamaruddin A.A. 1999. Barn Owls as a biological control agent of rats in paddy fields. Towards efficient biodiversity and bioresources management for effective biological control In: Proc. Symp. on biological control in the tropics, Serdang, Malaysia. MARDI Training Centre, Kuala Lumpur, pp. 85–88.
- Hakkarainen H. & Korpimäki E. 1996. Competitive and predatory interactions among raptors: an observational and experimental study. *Ecology* 77: 1134–1142.
- Klaas E.E., Wiemeyer S.N., Ohlendorf H.M. & Swineford D.M. 1978. Organochlorine residues, egg shell thickness, and nest success in Barn Owls from the Chesapeake Bay. *Estuaries* 1: 46–53.
- Lenton G.M. 1984. The feeding and breeding ecology of Barn Owls, *Tyto alba*, in peninsular Malaysia. *Ibis* 126: 551–575.
- Marti C.D. 1994. Barn Owl reproduction: Patterns and variation near the limit of the species distribution. *Condor* 96: 468–484.
- Marti C.D. & Wagner P.W. 1985. Winter mortality in common Barn Owls and its effects on population density and reproduction. *Condor* 87: 111–115.
- Martínez J.A. & López G. 1999. Breeding ecology of the Barn Owl *Tyto alba* in Valencia (SE Spain). *J. Ornithol.* 140: 93–99.
- Meyrom K., Leshem Y. & Charter M. 2008. Barn owl *Tyto alba* breeding success in man-made structures in the Jordan Rift valley, Israel. *Sandgrouse* 30: 134–137.
- Muller Y. 1989. Fluctuations d'abondance de la Chouette effraie *Tyto alba* en Alsace-Lorraine de 1977–1988. *Aves* 26: 131–141.
- Newton I. 1998. Population limitation in birds. Academic Press, London.
- Otteni L.C., Bolen E.G. & Cottam C. 1972. Predator-prey relationships and reproduction of the Barn Owl in Southern Texas. *Wilson Bull.* 48: 434–448.
- Petty S.J., Shaw G. & Anderson D.I.K. 1994. Value of nest boxes for population studies and conservation of owls in coniferous forests in Britain. *J. Raptor. Res.* 28: 134–142.
- Pikula J.M., Beklova M. & Kubik V. 1984. The breeding bionomy of *Tyto alba*. *Acta Sci. Nat. Acad. Sci. Bohemoslov. Bmo* 18: 1–53.
- Pokines J.T. & Peterhans J.K. 1997. Barn Owls *Tyto alba* taphonomy in the Negev Desert, Israel. *Israel J. Zool.* 43: 19–27.
- Shirihai H. 1996. The Birds of Israel. Academic press, London.
- Steenhof K. 1987. Assessing raptor reproductive success and productivity. In: Giron Pendleton B.A., Millsap B.A., Cline K.W. & Bird D.M. (eds) Raptor management techniques manual. Natl. Wildl. Fed., Washington, DC U.S.A, pp. 157–170.
- Taylor I.R. 1994. Barn Owls. Predator-prey relationships and conservation. Cambridge University Press, Cambridge.
- Tores M. & Yom-Tov Y. 2003. The diet of the Barn Owl (*Tyto alba*) in the Negev Desert. *Israel J. Zool.* 49: 233–236.
- Tores M., Motro Y., Motro U. & Yom-Tov Y. 2005. The Barn Owl—a selective opportunist predator. *Israel J. Zool.* 51: 349–360.
- Wilson R.T., Wilson M.P. & Durkin J.W. 1986. Breeding biology of the Barn Owl *Tyto alba* in central Mali. *Ibis* 128: 81–90.
- Yom Tov Y. & Wool D. 1997. Do the contents of Barn Owl pellets accurately represent the proportion of prey species in the field? *Condor* 99: 972–976.

SAMENVATTING

Vanaf 1983 zijn in Israël in het kader van een biologisch bestrijdingsprogramma tegen knaagdieren nestkasten voor Kerkuilen *Tyto alba* geplaatst, eerst alleen in de kibboets Sde Eliyahu, later ook in de rest van de Beit She'an vallei. In 1983 waren er 14 nestkasten op 3 km², in 2007 300 op 90 km². In dit artikel worden de resultaten van de broedseizoenen 2002 tot en met 2006 (156–243 nestkasten gecontroleerd per seizoen) besproken. De bezetting van de kasten varieerde van 48,1% tot 73,5% en bedroeg gemiddeld 53,5%. Dit leverde 596 broedpogingen op, waarvan 85,2% minstens één uitgevlogen jong voortbracht. De bezettingsgraad was het eerste jaar na het ophangen van de kasten lager dan later. De bezettingsgraad en het aantal nestjongen per jaar correleerden beide positief met de afstand tot de dichtstbijzijnde nestkast en negatief met het aantal nestkasten binnen een straal van 500 m. Tijdens het vijf jaar durende onderzoek waren 215 kasten (86,7% van de 248) minstens eenmaal bezet. De hoge bezettingsgraad toont aan dat aanvankelijk natuurlijke nestgelegenheid in de onderzochte landbouwgebieden ontbrak en dat het aanbrengen van nestkasten kan leiden tot een toename van het aantal Kerkuilen in zulke gebieden. Uit oogpunt van soortbescherming en de biologische bestrijding van knaagdieren een interessant gegeven.

ARDEA

TIJDSCHRIFT DER NEDERLANDSE ORNITHOLOGISCHE UNIE (NOU)

ARDEA is the scientific journal of the Netherlands Ornithologists' Union (NOU), published bi-annually in spring and autumn. Next to the regular issues, special issues are produced frequently. The NOU was founded in 1901 as a non-profit ornithological society, composed of persons interested in field ornithology, ecology and biology of birds. All members of the NOU receive ARDEA and LIMOSA and are invited to attend scientific meetings held two or three times per year.

N E T H E R L A N D S O R N I T H O L O G I S T S ' U N I O N (N O U)

Chairman – J.M. Tinbergen, Animal Ecology Group, University of Groningen, P.O. Box 14, 9750 AA Haren, The Netherlands

Secretary – P.J. van den Hout, Royal Netherlands Institute for Sea Research (NIOZ), P.O. Box 59, 1790 AB Den Burg, Texel, The Netherlands (hout@nioz.nl)

Treasurer – E.C. Smith, Ir. van Stuivenbergweg 4, 6644 AB Ewijk, The Netherlands (ekko.diny@planet.nl)

Further board members – E. Boerma, G.J. Gerritsen, J. Komdeur, J. Ouweland, G.L. Ouweneel, J.J. de Vries

Membership NOU – The 2010 membership fee for persons with a postal address in The Netherlands is €42 (or €25 for persons <25 years old at the end of the year). Family members (€9 per year) do not receive journals. Foreign membership amounts to €54 (Europe), or €65 (rest of the world). Payments to ING-bank account 285522 in the name of Nederlandse Ornithologische Unie, Sloetmarke 41, 8016 CJ Zwolle, The Netherlands (BIC: INGBNL2A and IBAN: NL36INGB0000285522). Payment by creditcard is possible. Correspondence concerning membership, payment alternatives and change of address should be sent to: Erwin de Visser, Sloetmarke 41, 8016 CJ Zwolle, The Netherlands (nou ledenadmin@gmail.com).

Research grants – The NOU supports ornithological research and scientific publications through its Huib Kluijver Fund and the 'Stichting Vogeltrekstation'. Applications for grants can be addressed to the NOU Secretary. Donations to either fund are welcomed by the NOU treasurer.

Internet – www.nou.nu

A R D E A

Editors of ARDEA – Rob G. Bijlsma, Wapse (Editor in chief); Christiaan Both, Groningen; Niels J. Dingemanse, Groningen; Dik Heg, Bern; Ken Kraaijeveld, Leiden; Kees van Oers, Heteren; Jouke Prop, Ezinge (Technical editor); Julia Stahl, Oldenburg; B. Irene Tieleman, Groningen; Yvonne I. Verkuil, Groningen

Dissertation reviews – Popko Wiersma, Groningen

Editorial address – Jouke Prop, Allersmaweg 56, 9891 TD Ezinge, The Netherlands (ardea.nou@planet.nl)

Internet – www.ardeajournal.nl. The website offers free downloads of all papers published in Ardea and forerunners from 1904 onwards. The most recent publications are available only to subscribers to Ardea and members of the NOU.

Subscription ARDEA – Separate subscription to ARDEA is possible. The 2010 subscription rates are €36 (The Netherlands), €42 (Europe), and €50 (rest of the world). Institutional subscription rates are €53, €69, and €78, respectively). Papers that were published more than five years ago can be freely downloaded as pdf by anyone through ARDEA's website. More recent papers are available only to members of the NOU and subscribers of ARDEA-online. Receiving a hard-copy with additional access to ARDEA-online costs €55 (The Netherlands and Europe), €70 (rest of the world), or €110 (institutions). Subscriptions to ARDEA-online (without receiving a hard copy) cost €40 (individuals worldwide), or €85 (institutions). Payments to ING-bank account 125347, in the name of Nederlandse Ornithologische Unie, Ir. van Stuivenbergweg 4, 6644 AB Ewijk, The Netherlands (BIC: INGBNL2A and IBAN: NL16INGB0000125347). Correspondence concerning subscription, change of address, and orders for back volumes to: Ekko Smith, Ir. van Stuivenbergweg 4, 6644 AB Ewijk, The Netherlands (ekko.diny@planet.nl).

World Owl Conference Special

Editors – David H. Johnson, Dries Van Nieuwenhuyse and James R. Duncan, in cooperation with Jouke Prop and Rob G. Bijlsma

Technical editor – Jouke Prop

Dutch summaries – Arie L. Spaans, Dries Van Nieuwenhuyse, Jouke Prop, Rob G. Bijlsma, or authors

Graphs and layout – Dick Visser

Drawings – Jos Zwarts

Cover photos – Serge Sorbi

front – Snowy Owl

back – Snowy Owl, Great Grey Owl and young Tengmalm's Owl

Production – Hein Bloem, Johan de Jong and Arnold van den Burg

© Nederlandse Ornithologische Unie (NOU), 2009

Printed by Van Denderen, Groningen, The Netherlands, December 2009