Ornithological Observations

An electronic journal published by BirdLife South Africa and the Animal Demography Unit at the University of Cape Town

Ornithological Observations accepts papers containing faunistic information about birds. This includes descriptions of distribution, behaviour, breeding, foraging, food, movement, measurements, habitat and plumage. It will also consider for publication a variety of other interesting or relevant ornithological material: reports of projects and conferences, annotated checklists for a site or region, specialist bibliographies, and any other interesting or relevant material.

Editor: Arnold van der Westhuizen

HOW TO MAKE 2.5 BILLION TERMITES DISAPPEAR? A CASE FOR PROTECTING THE AMUR FALCON *FALCO AMURENSIS*

Henk Bouwman, Craig Symes, Hannalene du Plessis

Recommended citation format:
Bouwman H, Symes C, Du Plessis H, 2012. How to make 2.5 billion termites disappear? A case for protecting the Amur Falcon *Falco amurensis*. Ornithological Observations, Vol 3:232-242

URL: http://oo.adu.org.za/content.php?id=69

Published online: 29 November 2012

- ISSN 2219-0341 -

HOW TO MAKE 2.5 BILLION TERMITES DISAPPEAR? A CASE FOR PROTECTING THE AMUR FALCON *FALCO AMURENSIS*

Henk Bouwman[1] *Craig Symes*[2] *Hannalene du Plessis*[1]

[1]School of Biological Sciences, North-West University, Private Bag X6001, Potchefstroom, 2520, South Africa
[2]School of Animal, Plant and Environmental Sciences, University of Witwatersrand, Private Bag 3, Wits, 2050, South Africa

*Corresponding author: henk.bouwman@nwu.ac.za

INTRODUCTION

The sudden and shocking discovery of the large scale harvesting of Amur Falcons *Falco amurensis* in India (Conservation India 2012; Figures 1-3) has, *inter alia*, raised the issue of why conservation of migratory species is so important. A 120 000–140 000 depletion in 2012 (probably occurring since 2006 at variable rates) of the global population of an estimated 50 000-1 million birds (various sources) is an impact that should be recognized as of great concern. Apart from a global biodiversity and conservation perspective, the migratory behaviour of this species (Symes and Woodborne 2010) also means that its predatory nature may have consequences in its breeding and non-breeding areas. In South Africa, the kestrelling.com website houses the collated roosting count data for this species since 2005/06. The maximum number for a coordinated January count for South Africa was 114 000 from 17 roosts in 2009 (Anon 2012). Many more roosts are known but are not counted, so the actual numbers in South Africa are no doubt much higher.

Fig 1 - Amur Falcon trapped in a fishing net in Nagaland (Conservation India)

Fig 2 - Captured live Amur Falcons kept "fresh" under a mosquito net. (Conservation India)

- ISSN 2219-0341 -

Fig 3 - Plucked and ready for sale. (Conservation India)

With this short article we want to document some of our observations and hope to raise the awareness of the ecological and economic contributions these birds make.

CASE STUDIES

One of the attributes associated with kestrels in general and the Amur Falcon in particular, is its insectivorous diet (Zank and Kemp 1996; Kopij 2009; Pietersen and Symes 2010). One may well ask how much insect prey is consumed by a bird, and what economic and ecological contribution it might have. The incident in India has prompted us to address this issue further, although we do not intend to present an exhaustive assessment.

Very little non-insect prey (such as lizards, small mammals, and birds) is consumed by the Amur Falcon and other kestrels in Southern Africa (Kopij 2007; 2009). Acrididae (grasshoppers) and Solifugae (sun spiders) seems to be the main prey of the Amur Falcon, followed by Gryllidae (crickets), Coleoptera (beetles), and a host of other primarily, invertebrate taxa, including Isoptera (termites) at much lower frequencies, in pellets. This probably resembles the normal everyday diet of the Amur Falcon in Southern Africa. We present some case studies for further consideration.

Case study 1 - Termites

Swarming of termite alates (the winged reproductive form of termites) and other insects present birds with an immediate and concentrated food source. The predation pressure on alates can be high. One 10-minute instance in Cote d'Ivoire saw a predation of 84% of the alates, all by birds such as bee-eaters, canaries, and bulbuls (Korb and Saleweski 2000). Alates are of course also predated by bats, reptiles, and amphibians.

In January 2004, while counting Amur Falcons coming in to roost in a large blue gum tree in Ventersdorp (South Africa) (Figures 4-6), the birds that already settled started to dive out of the tree, upsetting the counters to no end. When we saw that the birds were now feeding on an alate swarm, counting was suspended and we relocated to where we could observe the hunting. The birds flew low and between the houses swerving to catch the alates in flight, bending down to eat the prey in flight while discarding the wings. It was a very rainy late afternoon, with the sun peeking in below the overcast. Looking into the sun, a silver cloud of falling wings could be seen. The counters followed individual birds, timing the length of observation and the numbers of insects consumed. A mean of 1 alate every 3.3 seconds was calculated. After an hour, they began returning to the roost. We estimated 5 500 falcons. We also caught 14 alates and weighed them that evening. The mean individual mass was 0.089 g.

Fig 4 - The roost in Ventersdorp. (H Bouwman)

Fig 5 - Amur Falcons arriving at dusk at a rate of a 100 every 10 seconds. (H Bouwman)

With this data and with a few assumptions, we calculated the consumption of that roost for the evening. We assumed that a falcon would catch and consume at a rate of 1 alate every 3.3 s for 15 min (the feasting lasted about an hour). That would be 272 alates. We then rounded down to 250 alates per falcon per swarming episode, as the alates were swarming patchily, and birds had to locate patches, interrupting catching. Expressed as biomass, this represents about 22 g of termites per bird (15% of the Falcon mass). This is feasible as a falcon weighs about 150 g and a 10% crop content mass has been shown for larger raptors (Ostrowski *et al.* 2001). It seems that Amur Falcons do not have roost fidelity on the wintering grounds (Symes and Woodborne 2010). They are therefore likely to experience more than one swarming episode while spending about four months in Southern Africa, increasing the alate number and biomass consumed. In fact it may be because they move great distances that they are able to respond to irruptions in different parts of the country.

Table 1 presents item consumption and consumed biomass estimates for 1, 5 and 10 swarming episodes. The numbers are extraordinary; the roost at Ventersdorp (5 500 birds) consumed an estimated 1.4 million alates at 122 kg. We have also counted 10 000 birds at the same roost on more than one occasion representing a potential 2.5 million alates at 223 kg per episode. The numbers compound when five or ten episodes are involved. For 10 episodes, 10 000 birds could predate 25 million alates at 2.3 tons of biomass consumed. Extrapolated to even larger roosts, e.g. Newcastle, of ca. 20 000 birds the figures become phenomenal, and the impacts somewhat obvious.

Table 1. Estimated number of termite alates and biomass of alates consumed by various numbers of Amur Falcons and episodes.

Falcon (n)	1 Episode	5 Episodes	10 Episodes
1	250	1 250	2 500
1 000	250 000	1 250 000	2 500 000
5 500	1 375 000	6 875 000	13 750 000
10 000	2 500 000	12 500 000	25 000 000
130 000	32 500 000	162 500 000	325 000 000
1 000 000	250 000 000	1 250 000 000	2 500 000 000
Falcon (n)	Alate mass consumed (kg)		
1	0.022	0.11	0.22
1 000	22	111	223
5 500	122	612	1 224
10 000	223	1 113	2 225
130 000	2 893	14 463	28 925
1 000 000	22 250	111 250	222 500

The estimates from India on the number of birds captured in 2012 were 120 000-140 000. Assuming that 130 000 less birds reach Africa and if each bird experiences only one episode while here for four months means that 32.5 million alates at 2 893 kg will not be consumed (Table 1) [For comparison, a medium truck weighs 2.9 tons.] Since each bird returns numerous times, this effect is compounded over its lifespan.

Assuming a global population of 1 million birds, all wintering in Africa, produces astounding numbers (Table 1); 250 million alates representing 22 tons of biomass could be consumed for only one episode per bird. For ten episodes, 2.5 billion alates at 223 tons of biomass could be consumed. [For comparison, a 747 jet weighs about 272 tons.]

Fig 6 - Kestrels circling over Ventersdorp. (H Bouwman)

It should be remembered that each breeding pair of alates could establish one nest, producing thousands of termites that consume much vegetation biomass (fresh or dead) over many years. A reduction in avian predation (in addition to what other predators consume) would presumably increase the number of termite colonies and therefore pressure on agriculture, rangelands, and wooden constructions.

Termites also play a large role in ecology – any disturbance in numbers is therefore likely to affect ecology and ecological functions. In the Okavango Delta in Botswana, mound-building *Macrotermes* termites play a key role in the ecology of this large inland delta. “Thus, the initial activity of a single species [*Macrotermes*] sets in motion a complex successional sequence involving plants, mammals and the geohydrological and geohydrochemical regimes, the outcome of which is the undulating topography of the floodplains of the Okavango fan.” (McCarthy *et al*. 1998). Although little is known about kestrel roosts in the Okavango, it is very likely that a disturbance of a keystone taxon (termites) here or elsewhere may have far-reaching ecological consequences. Termites, therefore, are landscape engineers and Amur Falcons influence their numbers. Effects on the numbers of either might effectively alter system functioning at the landscape level.

Note on calculations:

We acknowledge that numerous assumptions were made in the calculations. Improved assumptions and new knowledge are likely to change the estimates.

Note on pellet content identification:

Soft bodied animals, such as alates, have very little hard pieces that will survive in a pellet (Kopij 2002). Therefore, it is likely that termite alates are under-represented when studying pellet remains.

Note on the nutritional value of alates:

Alates seem to be very nutritious. Dry mass of *Macrotermes* alates are almost 60% fat and up to 30% protein (Redford and Dorea 1984).

Case study 2 – Other insects

Apart from feasting on alate swarms, Amur Falcons have a normal daily diet. Table 2 assumes that each bird consumes about 15 g of invertebrates per day. The global Amur Falcon population, while in Africa, is estimated to consume 1 800 tons of prey, every season, while here. Added to one or more alate feasting episodes (we don’t know how to add this up), shows the extraordinary impact the falcons may well have on prey populations, including potential pests such as grasshoppers, locusts, and termites (Figures 7-8). Reducing the population by 130 000 birds also reduces its yearly contribution of invertebrate consumption in Africa by 234 tons or 13%. Large reductions in Amur Falcon numbers are therefore likely to have far-reaching but difficult to predict impacts on agriculture and the environment. Even then we are not even considering compound impacts over time from the insects not consumed, yearly population reductions in harvesting of Amur Falcons, habitat changes, and climate change.

Table 2. Invertebrate biomass (kg) consumed by various numbers of Amur Falcons over four months, assuming 15 g per day intake.

Falcon (n)	4 months (kg)
1	1.8
1 000	1 800
5 500	9 900
10 000	18 000
130000	234000
1 000 000	1 800 000

Fig 7 – Amur Falcon on the wing with grasshopper as prey (Rudy Erasmus)

Fig 8 – Amur Falcon settling to consume prey (Rudy Erasmus)

Case study 3 – American bollworms on sorghum

Sorghum is cultivated as a food crop for humans and animals as well as for production of alcoholic beverages and biofuels. It is the fifth most cultivated and consumed grain in the world after maize, rice, wheat, and barley (FAOSTAT, 2010). Almost 61% of the world sorghum production in 2009 was located in 41 African countries. As a continent, Africa produces the most sorghum in the world (21.9 million tons annually, equivalent to 39% of world production) (FAOSTAT, 2010).

An important pest of sorghum in South Africa is the African bollworm *Helicoverpa armigera*. Larvae can damage developing grain kernels from the milk to soft dough stages. The general recommendation for chemical control of bollworm on sorghum in South Africa is when an average of two bollworms occurs per panicle (the flowering/fruit structure). Efficacy of the insecticide is partially determined by how much insecticide or biological control agent reaches the larvae within panicles. Larvae are better protected in compact than in looser panicles (Du Plessis & Van den Berg, 1999).

The reproductive phase of sorghum in South Africa coincides with the time that the Amur Falcons are present in huge flocks in the sorghum production areas. A trial was done in February 2011 in a farmers' field in the Parys area (in the Free State province of South Africa) to evaluate the efficacy of a slow-acting biological control agent for control of African bollworm on sorghum. The birds were already present in the vicinity on the day of application. One day after application, swarms of Amur Falcons fed on bollworm larvae in the field. The birds flew low, just above the panicles and dove down

Fig 9 - Feeding damage of African Bollworm on a sorghum panicle. (H du Plessis)

Fig 10 - Amur falcons perching on sorghum panicles. (H du Plessis)

Fig 11 - Amur falcons in a sorghum field. Bird top right is probably feeding. (H du Plessis)

between the rows. Others sat on sorghum panicles feeding on the larvae in the panicle (which may not be reached by control agent due to protection afforded by the panicle). Landing of the bird on the panicle as well as feeding in the panicle caused bollworm larvae to fall to the ground from where diving birds then picked them up (Figures 9-12).

The falcons reduced the number of African bollworm larvae in the field to such an extent that the trial had to be suspended due to too low numbers of larvae occurring in both the trial and control plots. Annual biological control of African bollworm larvae by these falcons in areas where they roost will therefore contribute to a reduction in chemical insecticides needed by sorghum farmers for control of African bollworm.

Fig 12 - African bollworm on a sorghum panicle. (H du Plessis)

Case study 4 – Other birds predating on termites

Termites are an important food resource for many animals. At least 65 bird species are documented feeding on termites (alates and worker/soldier termites) in South Africa (Kok and Hewitt 1990), but this list is by no means comprehensive. In the case of migrant falcons they may be important for refuelling depleted energy reserves after a long distance migration.

Amur Falcons are primarily a grassland and open savanna-grassland bird in South Africa (Jenkins 2005). While the planting of trees, where large flocks roost communally, may have benefited the population, land transformation processes may have negatively affected overall numbers. Maize stem borers *Heteronychus arator*, Dynastinae have been recorded in the crops of Amur Falcons - so while much of the foraging habitat may have been transformed, agricultural monocultures may still provide birds with food (Pietersen and Symes 2010). However, if crop pests are regulated then food supplies for Amur Falcons may be compromised.

Case study 5 – Consumption of Amur Falcons in Malawi

Describing a large Amur Falcon roost in a clump of tall blue gum trees in Malawi (then Nyasaland) in 1951, Benson (1951) decided to confirm his identification and killed seven of the birds with one shot. Discussions with the local population revealed that, while the trees were still low, stones and knopkierries (a wooden throwing weapon with a knob at one end) were used to kill unknown numbers of birds that they called onomatopoeically Kakuwikuwi for eating. By then, with higher trees, only a few falcons were apparently taken. Taking his cue from this gastronomic hint (and no doubt feeling guilty about his destructive identification method) Benson and his servants dissected the birds, diagnosed them "fat", having flying ants in the crops, and cooked the evidence. "They are very good to eat." "I cannot liken the flesh to that of any other creature [no doubt having tried many], but it is very palatable."

It is very likely that Amur Falcons and related kestrels occurring in great numbers have attracted the attention of local communities in Africa, as indeed for any other large concentration of animals anywhere in the world (as in India recently). However, using only rudimentary projectiles, a significant impact is unlikely. It is prudent though, to keep on monitoring the protection of roosting sites in Africa as the use of nets as in India may also spread to Africa – a sobering thought, and a salute to Benson for publishing his notes.

CONCLUSIONS

We believe that we amply demonstrated the importance of Amur Falcons towards agriculture and ecology in South Africa and Southern Africa. Based on our calculations and observations, it may even be considered a keystone species. Any significant reduction in falcon numbers may have significant consequences and their conservation and maintenance of numbers seem critical. Aiming for only conserving a reduced but stable population, just to keep the species from going extinct, could be a serious blow to the ecology in the breeding and non-breeding grounds, and probably also at the stop-over sites (including those in India). Maintenance of the population *in toto* is therefore strongly advised. Although the conservation status of this species is currently of least concern, the sensitivity of this species towards sudden reductions combined with the concomitant ecological and economic consequences should be enough motivation for a re-evaluation.

Conservation actions

From the case studies, a number of conservation actions that should be taken up by conservation action plans present themselves. Considering the case studies above, some urgent conservation actions were identified.

Protection on migratory routes and stopover sites

The sudden upsurge in the harvesting of Amur Falcons in India is a stark reminder of the importance of protection along migratory routes. The practice of harvesting an internationally protected raptor should be immediately terminated and we are glad to see such steps being taken, but there are signs of political involvement as well which could be a major hindrance. This paper presents the arguments why a short-term and localised advantage may have severe consequences on a sub-continental scale, potentially affecting millions of commercial and emerging farmers. Increased termite herbivory may also result in increased need for pesticides to control them. Only now do we realise that the trans-continental effect of a single bird species (but likely also including the other migrating kestrel species) shows that long-range global environmental and economic benefits are in play. This is likely to be the case at both the breeding and non-breeding grounds and in between on the stop-over sites. Awareness raising of the contribution the Amur Falcon and other kestrels, on a sub-continental scale, is crucial.

Roost conservation:

In Africa, the migratory kestrels roost in large trees (sometimes in clumps or groves of large trees) even within urban areas. Such trees have been cut down (e.g. in Mafikeng and Potchefstroom) because of the "disturbance" (noise and smell) experienced by nearby residents. A much better understanding of the role of the kestrels is required. In addition, it is strongly advised that the relevant conservation authorities consider ways and means of protecting specific trees and groves. Although the area protected would be small, it seems obvious that the protection of a key feature is of utmost concern.

Good news is that the Headmaster of Ventersdorp Gekombineerde Skool (Combined School) and his wife have planted new trees to replace dead ones in a grove on the school property that is now being used by the falcons as their main roost (planted on 22/11/2012; Figures 13 and 14). Care and maintenance of trees and groves by residents is an excellent way of protecting roosts.

Fig 13 - Learners from Ventersdorp Gekombineerde Skool planting trees. The roost is on the left. (J Kleyn)

Fig 14 - Staff and learners at assembly learning about trees. (J Kleyn)

Research

Since 1991, for a bird with this much presumed impact, the number of scientific papers dealing directly with this species is about 10 (Web of Science November 2012). None we could find were about the falcon in its breeding grounds, although there are a number of papers listing them among other species. There is therefore an urgent need for more research on the ecology of the bird on its breeding and non-breeding grounds, and on the migration route. A multi-lateral research effort between the countries involved, as well as tracking of the birds could be done.

There are many more obvious conservation and protection actions required (rangeland conservation, reduction in pesticide use, prey identification, awareness raising, etc), but the major ones need urgent attention if the likely economic and environmental consequences of the dramatic depletion of Amur Falcon numbers are to be avoided.

- oo0oo -

Acknowledgements

Reinier Terblanche and Riana Botha for assisting with the counts in Ventersdorp in 2004. We thank Koos and Marietjie van Rensburg for taking care of the grove at Ventersdorp Gekombineerde Skool. Jeanette Kleyn (jeanetter.kleyn@truenw.co.za) from the Nuus/News@Ventersdorp newspaper and Rudy Erasmus is thanked for providing photos. Henrik Kylin is thanked for commenting on and corrections to the manuscript. Ramki Sreenivasan (Conservation India) is warmly thanked for permission to use the pictures reproduced here.

References

Anon 2012. Count data. http://www.kestreling.com/ on 14/11/2012

Benson CW 1951. A roosting site of the eastern red-footed falcon *Falco amurensis*. Ibis 93:467-468.

Conservation India 2012. Shocking Amur Falcon massacre in Nagaland. http://www.conservationindia.org/campaigns/amur-massacre on 14/11/2012

Du Plessis H, Van den Berg J 1999. African bollworm – a pest of grain crops. Crop Protection Series no. 16, ARC – Grain Crops Institute, Potchefstroom, South Africa.

FAOSTAT 2010 Crops primary equivalent. www.faostat.fao.org on 20/11/2012

Jenkins AR 2005. Amur Falcon *Falco amurensis* in: Hockey PAR, Dean WRJ, Ryan PG (eds) 2005. Roberts – Birds of southern Africa, 7th edn, The trustees of the John Voelcker Book Fund, Cape Town.

Kok OB, Hewitt PH 1990. Bird and mammal predators of the harvester termite *Hodotermes mossambicus* (Hagen) in semi-arid regions of South Africa. South African Journal of Science 86:34-37.

Kopij G 2002. Food of the lesser Kestrel (*Falco naumanni*) in its winter quarters in South Africa. Journal of Raptor Research 36:148-152.

Kopij G 2007. Seasonal and annual dietary changes in Lesser Kestrels *Falco naumanni* wintering in Lesotho. Ostrich 78:615-619.

Kopij G 2009. Seasonal variation in the diet of the Amur Kestrel (*Falco amurensis*) in its winter quarter in Lesotho. African Journal of Ecology 48:559-562

Korb J, Saleweski V 2000. Predation on swarming termites by birds. African Journal of Ecology 38:173-174.

McCarthy TS, Ellery WN, Dangerfield JM 1998. The role of biota in the initiation and growth of islands on the floodplain of the Okavango alluvial fan, Botswana. Earth Surface Processes and Landforms. 23:291-316.

Ostrowski S, Fromont E, Meyburg B-U 2001. A capture technique for wintering and migrating steppe eagles in southwestern Saudi Arabia. Wildlife Society Bulletin 29:265-268.

Pietersen DW, Symes CT 2010. Assessing the diet of Amur Falcon *Falco amurensis* and Lesser Kestrel *Falco naumanni* using stomach content analysis. Ostrich 81:39-44.

Redford KH, Dorea JG 1984. The nutritional value of invertebrates with emphasis on ants and termites as food for mammals. Journal of Zoology 203:385-395.

Symes CT, Woodborne S 2010. Migratory connectivity and conservation of the Amur Falcon *Falco amurensis*: a stable isotope perspective. Bird Conservation International 20:134-148.

Zank CM, Kemp AC 1996. A comparison of hunting behaviour by lesser kestrels *Falco naumanni* and Eastern Redfooted Falcons *Falco amurensis* in their non-breeding South African range. Ostrich 67:63-67.