3.3 Measuring the conservation threat that deliberate poisoning poses to birds in Kenya: The case of pesticide hunting with Furadan in the Bunyala Rice Irrigation Scheme

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3.3.1 Introduction

Poisoning is a latent and ruthlessly effective method of killing wildlife. In Kenya, pesticides are easily available and seen as efficient poisons to capture food for human consumption, in this case, birds. This is the phenomenon of 'pesticide hunting' practiced in my country. Our avian biodiversity is particularly vulnerable to such poisoning. Birds here are poisoned directly (for procurement of food and to eliminate species viewed as 'pests'), indirectly (through incidental and accidental poisoning), and secondarily (after consumption of other poisoned animals).

Kenya has the second highest avian diversity in Africa and the eleventh worldwide, boasting over 1 100 bird species, which is rather remarkable (Nature Kenya 2009; Mongabey 2010). Such diversity adds richness and value to the wildlife industry, which is Kenya's giant source of foreign income. Wetlands, whether natural or man-made, represent vitally important habitat to wildlife, particularly birds. A number of man-made wetlands in Kenya have been recognised as Important Bird Areas (IBAs). For example, the Dandora Oxygenation ponds in Nairobi (designated as KE IBA 35) are internationally recognised for their value to birds (Bennun and Njoroge 1999).

From a bird's perspective, irrigated fields such as those in the Bunyala Rice Irrigation Scheme are essentially man-made wetlands in which they may congregate to forage. Reports made in the early 1990s by Kenyan conservationists, particularly ornithologists, warned that wetland birds congregating in irrigation schemes were being hunted in large numbers, with pesticides (O. Nasirwa, personal communication). This is also in accordance with the author's own personal observations.

The study described here was initiated to investigate the extent of the deliberate poisoning of birds with pesticides in the Bunyala Rice Scheme, to quantify bird deaths, assess the implications of this practice to conservation, and highlight potential repercussions of consuming pesticide-poisoned birds to human health.

The specific objectives of the study were to:

1. Assess avian mortality as a result of deliberate pesticide baiting in the Bunyala Rice Scheme (during the study period).
2. Provide evidence to authenticate avian poisoning using pesticides at the study site.
3. Educate local communities on the dangers of pesticides (e.g., toxicity and misuse).
4. Inform government and NGO stakeholders on the outcomes of the study.

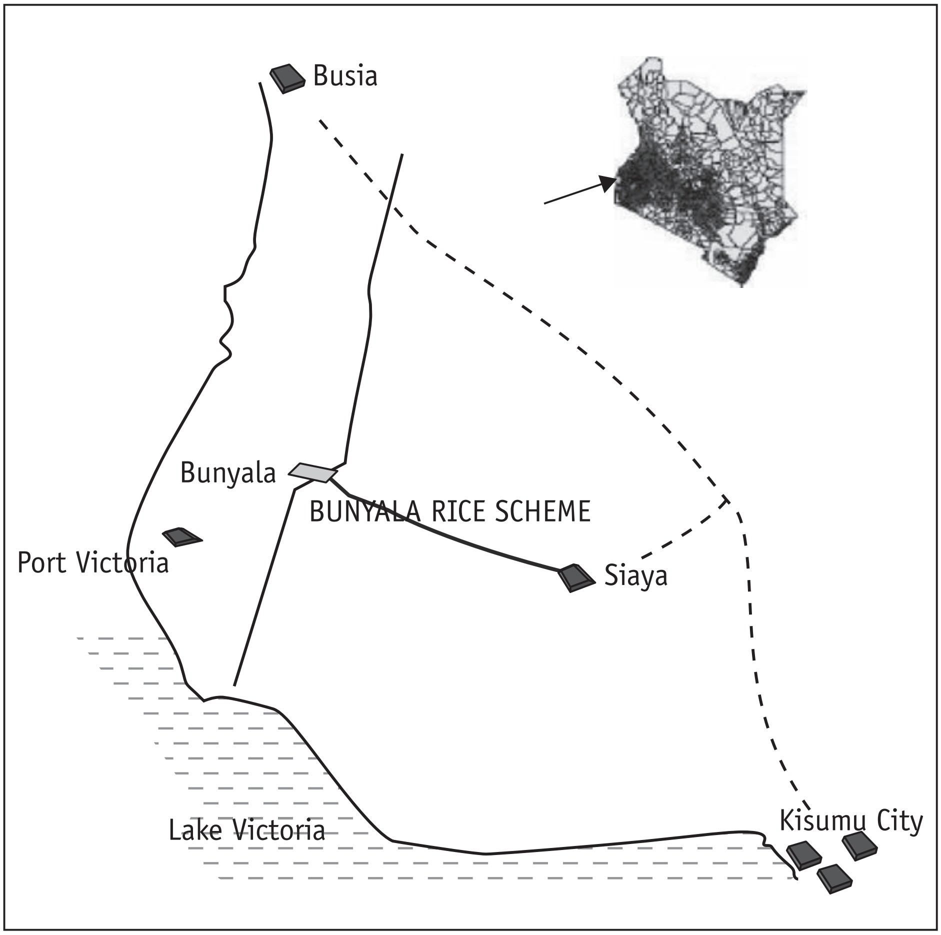

Figure 3.2 Study area and bird poisoning areas (detail) in Bunyala

3.3.2 Methodology

3.3.2.1 Study site and study area

The Bunyala Rice Irrigation Scheme (approximate central coordinates 00°05.797´N, 034°03.658´E) is located in Busia District, western Kenya. The study area encompassed an average radius of 5km around the irrigation scheme, which allowed us to establish the extensiveness of bird poisoning in Bunyala. The habitat is a dynamic man-made wetland; seasonally flooded at cultivation time and seasonally dry at harvesting time until the next period of cultivation. The study site spanned approximately 1 000 hectares of the main farmland and another 500 hectares of disjointed, smaller satellite farmlands. Figures 3.2 and 3.3 illustrate the distribution of poisoning in Bunyala (Magombe East and West). Figure 3.3 also indicates that other than a few outlying points to the east and south, the main rice scheme was the site of the majority of the poisonings.

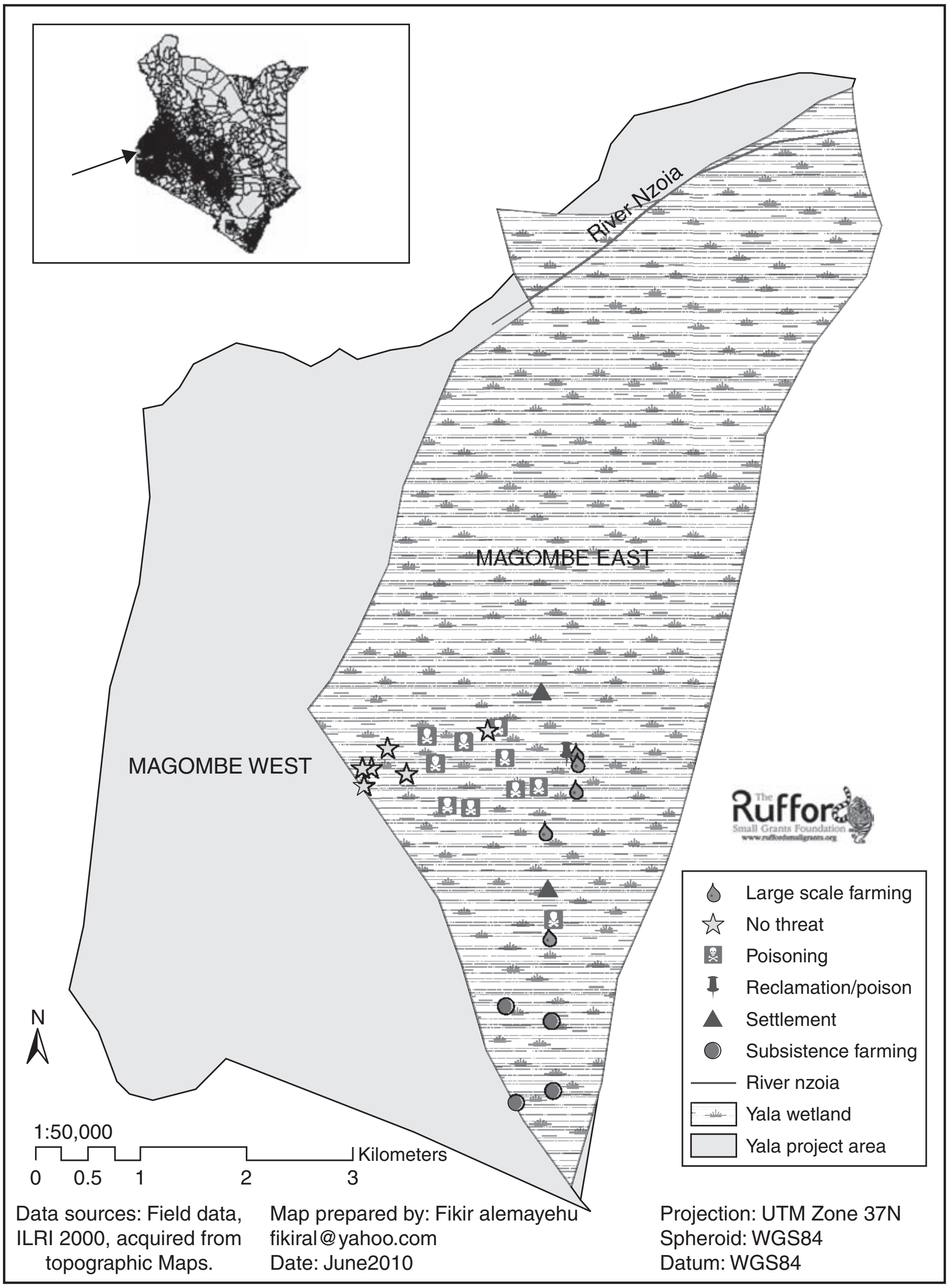

Figure 3.3 Study area and bird poisoning areas (detail) in Bunyala

3.3.2.2 Methods

Field work was conducted on site, between February and December (2009).

1. Stratified sampling survey

   The Bunyala rice plantation itself is large, but it has been subdivided into small rectangular plots, which served as the individual grids on which samplings and observations were made during the study. Each plot was delineated by soil embankment and occupied an average area of 0.75 acre. Grids were selected for sampling following opportunistic observation of pesticide poisoning there. Targeted bird species were partially identified on the basis of the type of baits set out. The number of targeted species was then recorded between the time that poachers put out the bait in the plot(s) and the time that the carcasses of the poisoned birds were gathered.

   Individuals that flew in during the 'waiting period', i.e., the duration that a poacher kept away from the quadrant where bait had been laid (and also that passersby were directed to keep off the poisoning site), were added to the total already recorded. This total represented the observed sample for each of the species. The individuals that flew out during this same 'waiting period' were included in the number observed since they too were assumed to be possible victims of intoxication. Once a poacher had gathered his kill, we approached and asked if we could identify and record each of the species killed. In some instances we had to estimate species from a distance to avoid unwelcome aggression from the poachers.

2. Questionnaires and interviews

   We sought permission from locals to survey them, explaining that we needed information about the bird poisoning industry to plan for the educational component of the study and to identify potential alternatives to the practices of poaching and consuming the flesh of poisoned birds (since we believe that both pose risks to human health). Two kinds of questionnaire were then administered for different respondent groups:

   (a) Poacher/hunter questionnaire: administered to those who poisoned birds, to obtain information regarding the manner of poisoning and to assess their attitudes towards their way of life.

   (b) Consumer questionnaire: targeted members of the general public who purchased poisoned birds/carcasses from poachers.

   The questionnaire was administered a second time, targeting individuals not approached during the first phase of the study, to evaluate the level of awareness and the effect (if any) of our attempts to 'educate'. Additional information was also obtained during informal question and answer sessions.

   ii. Thin Layer Chromatography (TLC) analysis

   A selected number of bird carcasses (n = 10, including one bait sample) were collected from the poisoning field while others were purchased directly from the poachers, (to avoid bias), for laboratory testing. Nine avian carcasses were eviscerated (i.e., the guts were removed), stored in glass tissue jars then kept frozen on ice in a cool box and transported to Nairobi for carbamate analysis (using TLC) at the Government Chemist Laboratory. A sample of the pesticide-laced rice bait/granules collected from the container in which the poacher's bait was stored was also tested.

3. Educational component

   The educational component of the study was conducted to enhance local people's appreciation of birds and their knowledge about pesticides, particularly Furadan, which had previously been established as the product of choice to poison birds in an earlier study, and during preliminary interviews and physical examination of poison baits for this study. Two local scouts were trained to identify and count (poisoned) birds, and to estimate the numbers in large flocks. The author, with the assistance of the two scouts, also educated other locals on the potential repercussions of Furadan to people and wildlife, mainly during informal sessions. The opportunity always presented itself whereby a few individuals became interested in learning what the project was all about and in the end the relevance of the project was presented to the gathered multitude.

4. Periodic reporting and blogging

   Monthly updates on the bird poisoning as it unfolded at the study site were provided to the Pest Control Products Bureau (PCPB) between March and July 2009. The activities related to the project and immediate findings were documented via a blog (http://stopwildlifepoisoning.wildlifedirect.org/). The aim of disseminating information through this popular form of online advocacy was to increase publicity and raise awareness of the issue with the general public, both locally and internationally. The blog also provided a means to share anecdotal information and catch the attention of government pesticide regulation authorities regarding the use of Furadan to deliberately poison birds both at the study areas and elsewhere (particularly other rice irrigation schemes) where there is a similar problem.

3.3.3 Results of the study

First, it was established that Furadan was used extensively to poison birds in the Bunyala Rice Irrigation Scheme. Furadan is often referred to as '*dawa*', which means a drug equivalent to a poison. In Bunyala, they call it '*dawa ya ndege*' (a poison for birds), even though it was initially introduced here for use in the rice plantation.

Our findings were obtained during ten-day monthly field surveys carried out from March 2009 to December 2009. Most of the data obtained was gathered by the PI and the Project Assistant (PA). Additional data obtained by the two local assistants, though less rigorous, was also incorporated. The percentage mortality threat was not calculated for birds that were collected by poachers but whose initial (live individual) totals were not estimated, which tended to occur when there were large flocks of mixed species. All poisoned individuals that were actually observed in an incapacitated state were documented. In some cases, poachers dislocated the wings and limbs of intoxicated birds to immobilise and prevent them from flying away in case they recovered. Still alive but clearly disoriented, these birds were then used as bait, to attract others of the same species.

Various food baits were laced with Furadan to lure and poison birds. Snails and termites (sometimes still alive) and small fish were laced with purple granules or powder from ground granules, while rice was soaked in a (purple) pesticide solution. Initially, the purple-blue granules were almost insoluble in water, but with stirring the solution became the colour of the granules. Poachers used stirring sticks (as shown in Figure 3.4) to prepare the solution and deemed it ready for use once it became a certain colour of purple, which they judged by eye.

By our estimation, poachers tended to use approximately one tenth of a teaspoon of granules in each individual snail bait, which they then used to lure snail-eating birds, particularly the African openbills (*Anastomous lamelligerus*). The birds needed only to ingest about three snail-baits (see Figure 3.5) to become very weak. Any remaining bait was then 'recycled' to poison other birds. Small birds like sandpipers took about one minute to get 'wobbly', whereas larger birds such as storks could take ten minutes before being similarly impacted. This observational component was one of the most difficult parts of my study, to see birds broken and dying, to love birds and not be able to help them because it was necessary to maintain objectivity for the study and avoid bias.

3.3.3.1 Results of bird mortality by pesticide poisoning

Overall, 3 186 victims of Furadan poisoning were documented (see Figures 3.6 and 3.7). This is out of the total 8 659 individual birds that were observed visiting the field plots in the irrigation scheme, and represents a 37% mortality rate, across 32 species. Four hundred and fifty two (452) of 1 005 palaearctic

Figure 3.4 Poacher mixing poison for baits by hand
Photo taken by Martin Odino

Figure 3.5 *Pila ovata* snails used for baiting the African openbill (*Anastomous lamelligerus*). Poison granules appeared as purple-blue in the cavities of the snail shells
Photo taken by Martin Odino

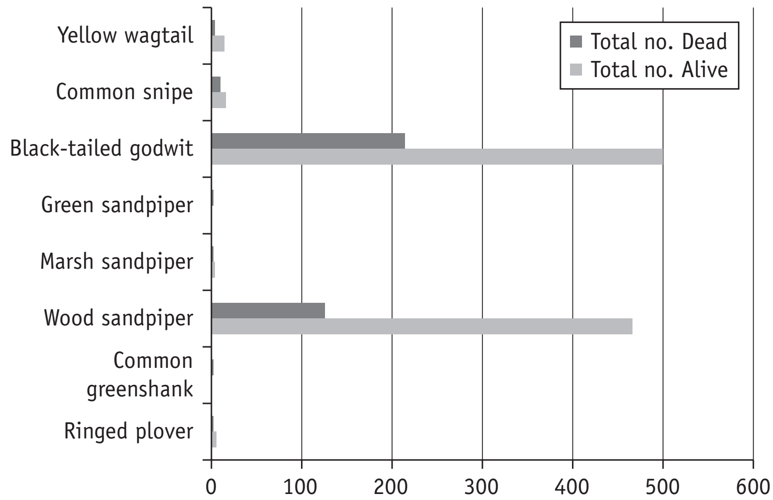

Figure 3.6 Observed palaearctic migrant bird visitors/mortalities per monitoring plot

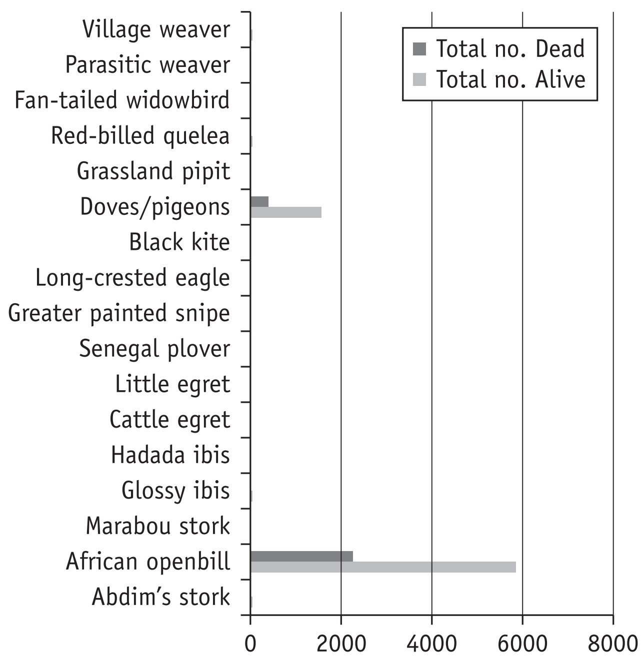

Figure 3.7 Observed resident and intra-African migrant bird visitors/mortalities per monitoring plot

Table 3.7 Results of observed cumulative palaearctic migrant bird mortalities in all quadrants (plots)

Species	No. alive	No. dead	Percent mortality
Ringed plover	5	2	40
Common greenshank		2	
Wood sandpiper	467	126	26.98
Marsh sandpiper	3	2	66.7
Green sandpiper		1	
Black-tailed godwit	500	215	43
Common snipe	16	10	62.5
Yellow wagtail	14	4	28.57
Ruff		3	

Table 3.8 Results of observed cumulative resident and intra-African migrant bird mortalities

Species	No. alive	No. dead	Percent mortality
Abdim's stork	29	26	89.69
African openbill	5848	2261	38.66
Marabou stork	10	3	30
Glossy ibis	39	6	15.38
Hadada ibis	6	1	16.67
Cattle egret	21	9	42.86
Little egret	8	3	37.5
Senegal plover		4	
Greater painted snipe	4	1	25
Long-crested eagle		2	
Black kite		1	
Doves and pigeons	1570	391	24.9
Grassland pipit	2	1	50
Red-billed quelea	50	12	24
Fan-tailed widowbird	11	8	72.72
Parasitic weaver	6	4	66.67
Village weaver	50	2	4

migrants were lost, representing an annual rate of 45% mortality. In addition, 2 734 of the observed 7 654 intra-African migrant birds were poisoned, which represented a mortality rate of nearly 38%.

The analysis that follows examines the impact of poisoning (and the subsequent population decline) on palaearctic migrants, birds that winter in Africa from Europe; e.g., wood sandpiper (*Tringa glareola*), black-tailed godwit (*Limosa limosa*) and the intra-African migrants which move within Africa, including the African openbill, Abdim's stork (*Ciconia abdimii*) and glossy ibis (*Plegadis falcinellus*). The comparative mortality within species (mortality against total numbers) and individual species losses (percentage mortality rate) are tabulated in Tables 3.7 and 3.8.

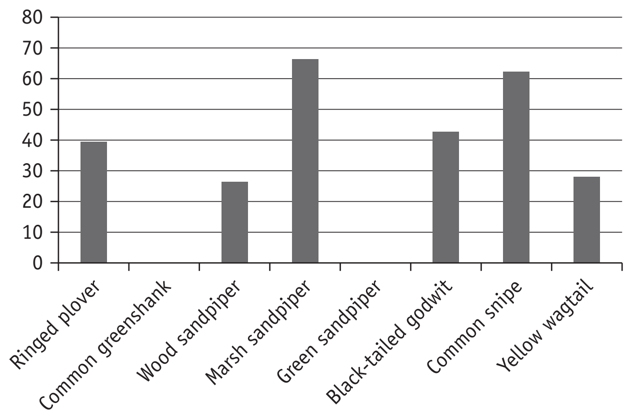

Figure 3.8 Percent mortality of palaearctic birds

The highest mortality amongst palaearctic migrants was noted in the black-tailed godwit: 215 of 500 observed individuals succumbed to poisoning. Wood sandpipers were the second most poisoned palaearctic bird, with 126 of 467 individuals poisoned. The green sandpiper (*Tringa ochropus*), marsh sandpiper (*Tringa stagnatilis*), common greenshank (*Tringa nebularia*), ruff (*Philomachus pugnax*) and ringed plover (*Charadrius hiaticula tundrae*) were poisoned in comparatively smaller numbers (less than 100 individuals) but they are also less abundant. From these results we concluded that the number of palaearctic individuals killed by poisoning is directly proportional to the flock or group size of the species.

As shown in Figure 3.8, mortality rate expressing percentage losses per species was highest in marsh sandpipers followed closely by the common snipe (*Gallinago gallinago*), black-tailed godwit, ringed plover, yellow wagtail (*Motacilla flava*) and finally the wood sandpiper. Percentage mortality in this case was highest in less common (or abundant) species. The values presented in Table 3.7 show that the wood sandpiper was the second most killed species, but suffered the lowest mortality rate. In contrast, the marsh sandpiper endured 'negligible' total mortality but suffered the highest mortality rate (Table 3.7). This indicates that the less common species were more adversely affected.

Table 3.8 summarises mortality against total numbers observed for resident and intra-African migrant bird species. Of the resident and intra-African migrants, the African openbill was by far the most poison-killed species. Two thousand two hundred and sixty one (2 261) of 5 848 individuals exposed to poisoning died. In fact the openbill suffered the highest mortality from poisoning overall, accounting for 26% of all mortality observed at the site. Mixed species of doves and pigeons were the second most poisoned bird family (391 of 1 570 poisoned). These species were lumped together because they associated closely and distinguishing one from another was difficult. The Abdim's stork was the third most poisoned species while the rest followed regressively with mortalities of less than ten individuals each. As was the case for the palaearctic migrants, the most abundant intra-African migrant species were also the most poisoned.

The African openbill was poisoned using a 'unique' baiting technique that employed live decoys whose beaks were fastened with string or a rubber band (to prevent them from eating the poison laced bait (*Pila* sp. snails)) and whose feet were tied to restrict movement. The poachers went around disturbing nearby flocks of openbills which then only had the option of settling around the decoys and baits otherwise the disturbance went on and on. This practice increased the incidence of openbill poisoning.

In Bunyala (and undoubtedly elsewhere) decoy birds are captured and kept to lure other birds of the same species (see Figure 3.9). The presence of the decoy suggests to the unsettled birds that there

Figure 3.9 Live openbill decoys and poisoned victims
Photos taken by Martin Odino

is a food source, and many flocks are fooled. Birds in the best body condition, with minimal injury, are selected from a poacher's catch as decoys. Poachers then carry the decoy birds home as part of their 'hunting gear' and back to the killing grounds during the next poisoning exercise.

The percentage mortality rate of each of the poisoned resident and intra-African migrant birds was calculated and plotted (Figure 3.10). Abdim's stork had the highest mortality followed by fan-tailed widowbird (*Euplectes axillaris*), parasitic weaver (*Anomalospiza imberbis*), grassland pipit (*Anthus cinamomeus*), cattle egret (*Bubulcus ibis*), African openbill, little egret (*Egretta garzetta*), Marabou stork (*Leptoptilos crumeniferus*), greater painted snipe (*Rostratula benghalensis*), red-billed quelea (*Quelea quelea*), Hadada ibis (*Bostrichia hagedash*), glossy ibis (*Plegadis fulcinellus*) and village weaver (*Ploceus cucullatus*). Eight of 11 fan-tailed widowbirds were poisoned, giving them the second highest rate of mortality. The African openbill had the highest mortality rate.

Results of questionnaires and interviews

Thirteen questionnaires were administered to poachers and 207 (62 at the start of the study and pre-education stage; 180 at about the end of the study) to consumers.

Poachers' responses

Five poachers were interviewed at both the pre- and post-education stage of the study, and an additional four were interviewed at the end of the study (one of the poachers initially interviewed, who was between 60 and 70, quit poaching to become a herder, purportedly due to old age). Poachers hunted birds in teams and so the additional four poachers might simply have given the same information as that obtained from the four already questioned during the pre-education stage. Nonetheless they were interviewed to evaluate any ideological differences that might exist amongst the teams.

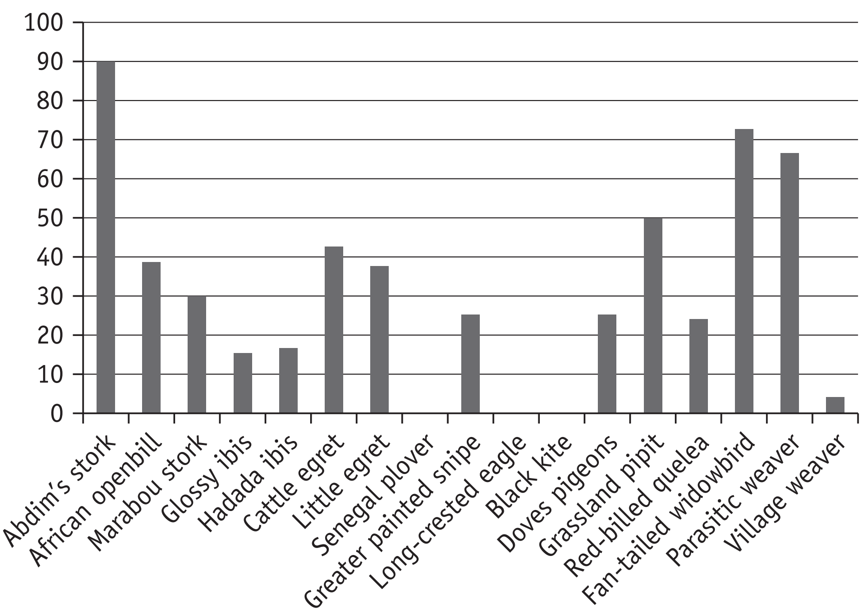

Figure 3.10 Percentage mortality of resident/intra-African migrant birds

All eight poachers had been poisoning birds for more than five years. Five of the poachers claimed that poaching birds was their sole source of income. Every poacher named Furadan as their poison of choice. Two of the poachers indicated they had attempted to use a silvery granulated compound that had replaced Furadan during July 2009. From their description we suspect that the pesticide in question was Mocap (which contained the organophosphorus compound ethoprop). Both stated that the compound was pungent and repelled rather than poisoned the birds. Further, this other pesticide gave the poachers respiratory problems, which they did not appreciate.

All the poachers stated they were aware of the toxicity of Furadan. However, they also claimed that washing their hands and specially preparing the carcasses before eating eliminates any residues of carbofuran. Indeed, once a bird is poisoned, the entrails are removed, the bird is hung to drain the fluids then it is slow heated and partially roasted in the traditional manner, as with animals killed with poisoned arrows. After this process, the birds are cooked and eaten. Poachers interviewed during the second phase of interview (after we had conducted the educational component) knew that Furadan affects the central nervous system. Despite this, all still held firmly to the belief that draining/heat treatment prior to consumption 'detoxified' a carcass.

During the first phase of questionnaire administration, some of the poachers said their poaching frequency varied, depending on need. They stated that they would poison daily, especially during the rice planting season (which varies depending on the rains). One specialist poacher who targeted doves and pigeons stated that he poached seasonally, during the two months or so that rice was harvested, when the number of birds in the irrigation fields was greatest. At other times he made his living as a self-trained electronics repairman. The fifth poacher said he poisoned birds daily.

Four of the five poachers stated that they poisoned the African openbill as a priority, but also waders and seedeaters if the wild storks had become imprinted against, or habituated to, the decoy birds. The fifth poacher focused on poisoning doves and pigeons, but like the rest also poached waders and seedeaters opportunistically. Specialising in baits and species reduces conflict, because even if intoxicated birds crossed into adjacent poisoning 'territories', poachers tend to respect the fact that it is another's quarry, providing it is not the same species they are targeting. In that case, disputes between poachers arise for quarry. All five respondents used the same cost scale for poisoned birds, i.e., highest prices for larger birds such as openbill, and lower prices for the smaller waders and seedeaters (e.g., pigeons, doves, pipits, widowbirds, weavers), as summarised in Table 3.9.

Due to the adverse publicity from the international community and a resultant (attempted) buyback by FMC, the manufacturer, the price of Furadan rose sharply during the study period. In the first part of the study, while the chemical was still readily available, it cost approximately 100 Kenyan Shillings (1.25 USD) per 200 gram pack. At the end of the study the product was not easily available and the price had risen to approximately 800 KSh (10 USD) which resulted in a corresponding increase in the prices of preferred species (African openbill, doves/pigeons, sandpipers, widowbirds/weavers/pipits). The reader will note that even with the price hikes, the cost of bird meat ranged from a value of 0 to approximately 5 USD.

Consumers' responses During the first phase of the questionnaires/interviews, two respondents stated that they ate wild bird meat daily; one was the wife of a poacher and the other was a primary school class 6 child (aged approximately 11). Sixty consumers responded that they purchased bird meat opportunistically, when the poachers/vendors came by with the meat or when they found it for sale at the local market. In the second phase, 112 respondents out of 180 stated that they purchased bird meat opportunistically whereas 68 refused to answer the question of how frequently they consumed birds. None said that they fed on poisoned bird meat because no other source of protein was available, which was among the options provided in the questionnaire.

In the first phase of questionnaires/interviews, 19 of 62 consumers (i.e., 31%) stated that they preferred bird meat to other sources of protein while in the second phase 29 out of 180 (i.e. 16%) preferred it. All the respondents were also aware that the birds were obtained from the wild and poisoned with Furadan, but they maintained that draining fluids from the carcasses by slow roasting

Table 3.9 Bird meat price list per individual unit (in KSh and USD[a])

	Phase I of interviews/ questionnaires		Phase II of interviews/ questionnaires	
Species/family	Raw KSh/USD	Dried/Roasted KSh/USD	Raw KSh/USD	Dried/Roasted KSh/USD
African openbill	50/0.60	70/0.87	80/0.99	100/1.2
Marabou stork	400/4.97		400/4.97	
Ibises and egrets	40/0.50		40/0.50	
Pigeons and doves	20/0.25	40/0.50	40/0.50	50/0.60
Sandpipers	10/0.1		20/0.25	
Widowbirds/ weavers/pipits	5/0		10/0.1	

[a]1 USD = ca 80 KsH

or hanging the carcasses over glowing firewood embers before cooking 'detoxified' the flesh/carcasses. Nonetheless, they acknowledged that the pesticide being used, Furadan, was deadly toxic. In a sidenote, a woman in Bunyala was reported to have used Furadan to poison her husband and her children for her husband's infidelity. In fact, Kenyan women are rarely allowed to purchase pesticides from an agrovet's shop because of the fear that they will use it to poison a husband who has been unfaithful.

The consumers interviewed also stated that they ate many of the species shown in Table 3.9. However, the African openbill and the doves/pigeons were clearly favoured, having been named by 219 of the 242 consumers (i.e., 90%). It is also worth noting that while all 62 respondents in the first interview phase freely answered the question regarding which birds they consumed, 23 out of the 180 respondents (i.e., 13%) would not respond in the second phase. The consumers reported that they had no particular supplier but could obtain wild bird meat by placing an order with any of the poachers to supply them. The prices quoted by consumers matched that shown in Table 3.9.

3.3.3.2 Results of Thin Layer Chromatography Analysis

Presence of a carbamate (i.e., carbofuran) was detected in the sample labeled 'BAIT' which was recovered from one of the jars used by a poacher to prepare his bait. The same results were consistent in the 'GUT' samples 1, 2, 3 and 7. No other chemically toxic substances were detected in the 'GUT' samples.

3.3.3.3 Impact of education and awareness on Furadan poisoning

Education was used as a tool, to empower locals in the study area and change their perspectives about poisoning and eating intoxicated birds. Two local assistants were trained for this purpose. Although the study has now been completed, these individuals remain involved in monitoring poisoning activities and recruiting others to join the local bird watching team, which also advocates against bird poisoning (see Figure 3.11).

Informal and opportunistic sessions were conducted with both poachers and consumers, to generate awareness about the risk that Furadan and other compounds may pose to human health. However,

Figure 3.11 Poachers being educated about birds and their values
Photo taken by Martin Odino

we were confronted by the widely held and virtually unshakeable belief that Furadan-poisoned bird meat is 'detoxified' by roasting or hanging prior to consumption.

Since no human mortality cases that could be directly linked to pesticide poisoning have yet manifested themselves, the locals were not appreciably convinced that consuming birds poisoned with Furadan was significantly harmful to them. We were often told that 'nobody reads the labels' and, if we told anyone (poachers included) that they should not touch the compound with their bare hands they essentially said: 'we have been touching it since before you were born and we are not dead yet'. Nonetheless, some poachers were persuaded to change to vegetable farming, using the abundant water resource from River Nzoia and receding waters of the customary annual floods in the area after the PI (M. Odino) enumerated the advantages of farming over poaching.

Regular blogging on the WildlifeDirect platform at http://stopwildlifepoisoning.wildlifedirect.org/ and http://baraza.wildlifedirect.org/ as the study progressed helped raise the international profile and visibility of this issue. The timing of the study also coincided with the airing of the '60 Minutes' segment on a major American television network and the subsequent buy-back offer by FMC, the manufacturer of Furadan.

While the product is now scantily available in most agrovet shops, it remains available both in Kenya and adjoining countries. Monthly updates on Furadan-associated bird mortality at the study site were made available to other stakeholders, namely the Kenyan Wildlife Service (KWS), Nature Kenya (Birdlife International's local partner), Crop Life Kenya (formerly Agrochemicals Association of Kenya (AAK)) and the PCPB. Talks between conservationists, particularly WildlifeDirect, and PCPB following a government ministerial (Agriculture) directive to look into the case are underway in an attempt to better regulate Furadan and other potentially deadly pesticides. Unfortunately, this venture does not seem to have moved forward very much.

3.3.4 Discussion

A significant proportion of mortality was observed in birds that visited plots where pesticide-laced baits were placed; 36% of all birds that visited the plots in which pesticide-laced baits were left in the irrigation scheme were killed. As such, it is entirely fair to say that the populations of a number of intra-Africa and palaearctic species are currently being decimated. The black-tailed godwit, for example, was listed in 2010 as Near Threatened by the IUCN (http://www.iucnredlist.org/apps/redlist/details/143984/0).

The Bunyala Rice Irrigation Scheme is located on a major migratory flyway, which means that unless the poisoning is addressed, populations will continue to decline. Wetland birds, including storks, egrets and waders, are the primary victims of deliberate poisoning. Grassland birds and birds of prey are attracted by the concentration of food resources at the rice irrigation plantation, and their numbers suffer accordingly. Only frugivorous birds were not affected at this study site.

Flocking birds were the primary target of pesticide hunting of all the species poisoned (i.e., 87.5%, or 28 of 32). Jointly, four species of raptors and non-flocking birds were also casualties of poisoning: long-crested eagle (*Lophaetus occipitalis*), black kite (*Milvus migrans*), yellow-throated longclaw (*Macronyx croceus*) and grassland pipit (*Anthus cinnamomeus*). The African openbill, doves/pigeons (see Figure 3.12), black-tailed godwit and wood sandpipers (see Figure 3.13) were the most frequently killed species.

Occurrence (seasonality) also determined the intensity of poaching, and therefore, the level of mortality. Overall, resident species suffered higher mortality rates. The African openbill endured the heaviest mortality because it is a flocking species and is also present year round at the site. Hunting this species is enhanced using decoy methods of baiting leading to a very high mortality of the species. These factors likely made the openbill the bird of choice amongst poachers and consumers over time. Considering its size, the openbill stork is sold at a very low price and as a result, it is preferred

Figure 3.12 Mixed species of doves being gathered from the poisoning field
Photo taken by Martin Odino

Figure 3.13 Poisoned wood sandpipers (*Tringa glareola*)
Photo taken by Martin Odino

by most consumers and killed in large numbers. The Marabou stork is sometimes referred to as '*mbuzi*', (i.e., the 'goat') because it is such a large bird.

Most other resident and intra-African birds are seasonally abundant (i.e., only found within the irrigation scheme when there is a crop). This was particularly the case for the doves and pigeons, which only flocked to the irrigation scheme at harvest time. Likewise, the palaearctic migrants are only seen in winter, since their breeding grounds occur in the northern tropics. However, certain palaearctic migrants are especially susceptible to poisoning, despite the short duration of their seasonal occurrence. Incoming palaearctic migrants are particularly vulnerable because they arrive hungry and will gorge themselves at stopover sites such as Bunyala. The black-tailed godwit suffered very high mortality rates (of 43%) after feeding on laced bait. This migrant species was only observed at the site at the in-coming stage (August to December) of migration and not during the return (early in the year when the study began in February and lasted until May) when it probably follows a different return route. In contrast, the wood sandpipers occurred both at the in-coming and return migrations, but suffered lower casualties than the godwit.

Some species were very easily poisoned with pesticides. For example, the Abdim's stork was readily drawn towards the bait and continued consuming poison-laced bait even if they saw other members of their flock becoming intoxicated and disoriented. By contrast, the open-billed stork is warier, and is alerted by the apparent intoxication of flock members. As such, repeated baiting sessions were sometimes required to kill this species.

Cultural practices and beliefs have entrenched the practice of poisoning birds in Bunyala. Even so, the problem may be more to do with attitude than culture. Many people believe that God has given what is in the wild to the people, and they will even point to passages in the Bible to justify their behaviour. People will often see a wild animal such as a baboon or wild boar and exclaim '*kitu mbaya*', meaning: 'the thing is bad'. Thus we seem to have an attitude problem towards our wildlife, associating certain wild animals with wickedness, when it is we who are wild towards them.

The questionnaires and interviews revealed that Furadan was the pesticide of choice and may still be in use at the study site. Toxicological assessments of baits and tissues from dead birds confirmed the presence of a carbamate. All of the poachers and consumers interviewed knew about (and supported) the practice of bird poisoning. Between 15 and 30% of the consumers stated that they preferred wild-caught bird meat to other sources of meat, claiming that it is tastier and more nutritious. This motive to consume birds that have been killed with pesticides is so strong that it overrides any knowledge of the dangers of potential secondary poisoning. The market for poached meat is large and has thus far been responsible for creating the demand that drives the poaching.

We documented a general lack of awareness/concern regarding risks of human pesticide poisoning from the practice of poaching and from consuming flesh of intoxicated birds. The people of Bunyala (poachers and consumers) hang and roast poisoned bird carcasses prior to consumption. As such, they feel the flesh of poisoned birds is safe to eat and claim to feel no ill effects. However, a poacher's wife (who claimed she ate poached bird meat every day) died early in 2010 from unknown causes, and we cannot help but wonder whether long-term exposure to pesticide-killed birds played any role. During our interview, she was nursing knee joint paralysis and was using a walking stick. This caught our attention because in the Mwea irrigation scheme (in central Kenya), they cook pesticide hunted birds fresh (rather than roasting or draining first), and many adults complain of knee joint pain.

Bird poisoning in Bunyala is already having a significant impact on local and migratory bird populations and may have already wiped out a number of local duck species populations. Bird poisoning at Bunyala has been going on for three decades at least, and information from locals indicates that initially wild ducks were mainly targeted. These include the whistling ducks (*Dendrocygna sp*) (J. Achieno, personal communication). Presently, very few of the ducks remain at the site and on many surveys none were observed (M. Odino, personal observation). In other irrigation schemes (i.e., Ahero and Mwea), where there were also surveys to record the incidence of bird poisoning, duck species were targeted. We suspect that the poisoning of wattled starlings (*Creatophora cinerea*) in Bunyala may have reduced the population to very small numbers since large flocks of this species, which were commonly seen with cattle about two decades ago (J. Achieno, personal communication), are sadly now a thing of the past.

Red-billed oxpeckers (*Buphagus erythrorhynchus)* also seem to be declining but this is more likely because of the intensive acaricide use, many of which should not be used for tick control. At one time it was common to see oxpeckers hanging from the ears of cows (to remove the ticks) but farmers chased them away and treated the cows with acaricides instead. Long-tailed nightjars (*Caprimulgus climacurus*) have recently been observed in the Bunyala area, which is very special because they have never before been reported here. But under the present circumstances and conditions they are likely to be forced out, and where else can they go to be safe? They will be lost before anyone even knew they were here.

3.3.5 General conclusions

The very high rate of bird poisoning in the Bunyala Rice Irrigation Scheme, using Furadan, is primarily driven by the demand for wild bird meat by the local population. The practice of pesticide hunting in this scheme poses a double threat in Kenya and to Kenyans. First, important bird populations are at risk and populations of at least two species have been altered significantly, perhaps irreversibly at the present rate of poisoning. Secondly, the regular consumption of bird flesh that has been procured using pesticides exposes consumers to potentially lethal concentrations.

Deliberate poisoning of birds is impacting on populations of both migrant and resident bird species. The most significantly affected species is the African openbill. During a good proportion of the study period (i.e., May to November 2009) the availability of Furadan was limited following its withdrawal from Kenya by the manufacturer FMC. We suspect that the mortality figures that we have reported here are lower than for previous years when the product was widely available.

In Bunyala, the practice of consuming wild meat does not arise from a lack of alternative protein. The practice has become a habit nurtured by the belief that wild-caught meat is best (and it helps that such meat is also less expensive than the alternatives). Local inhabitants of Bunyala are moderately successful domestic animal farmers who keep a modest number of livestock animals, including chickens, but they only eat these on special occasions. We also found that bird poachers were willing to abandon poaching for farming if provided with initial financial support to start vegetable growing and other legal businesses. However, poaching and consuming wild (bird) meat as a way of life remains deeply ingrained in people.

3.4 The role of carbofuran in the decline of lions and other carnivores in Kenya

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3.4.1 Background information

African wildlife populations have been in decline since European colonisation in the 1800s. Ever-increasing numbers of humans have destroyed habitat through conversion to agriculture and over-grazing by domestic livestock, and wild grazers have been decimated by the bushmeat trade. Large carnivores are usually the first species to disappear when humans expand into wild areas, killed in retaliation for depredation on livestock (Woodroffe 2001).

As pastoralist populations increase in arid and semi arid rangeland ecosystems, cattle, goats, sheep and camels replace native wild ungulates which are the normal prey of lions (*Panthera leo)*, leopards (*Panthera pardus*), cheetahs (*Acinonyx jubatus),* spotted hyenas (*Crocuta crocuta),* and wild dogs (*Lycaon pictus*). The predators turn to livestock and are poisoned, speared or shot. Although there are no reliable data for earlier periods, until recently conservationists estimated a continental population of 100 000 to 200 000 lions (Myers 1975; Nowell and Jackson 1996), evidence that they were still widespread and common. By today's best estimate, fewer than 30 000 wild lions remain in Africa, most of them in six very large national parks or managed areas (IUCN 2006). Most other protected areas are too small to protect viable populations of wide-ranging animals, as they move beyond park boundaries and come into conflict with people. In Kenya today, we believe lion numbers to be well below 2 000. Outside of national parks, it is rare to find tracks or hear them roaring.

Large carnivores have been in conflict with man over livestock depredation since ungulates were first domesticated by pre-agricultural humans. Traditional livestock husbandry systems prevent most depredation losses through close herding by day and enclosing livestock in thornbush bomas (i.e., enclosures) at night to prevent them from wandering (Ogada, Woodroffe, Oguge et al. 2003; Frank, Woodroffe, Ogada et al. 2005; Woodroffe, Frank, Lindsey et al. 2007). However, depredation losses can represent a considerable threat to the livelihoods of both traditional pastoralists and