Measuring the conservation threat to birds in Kenya from deliberate pesticide poisoning : a case study of suspected carbofuran poisoning using Furadan in Bunyala Rice Irrigation Scheme

A report to the Ornithology Section of the National Museums of Kenya, the Kenya Wildlife Service, Nature Kenya, Birdlife African Partnership Secretariat, Wildlifedirect, Pesticide Control Products Board of Kenya, Ministry of Agriculture, Ministry of Health, Ministry of Public Health, Ministry of Tourism & Ministry of Forestry and Wildlife Management

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7/30/2010

Funded by

The Rufford Small Grants Foundation
www.ruffordsmallgrants.org

Collaborators

Wildlifedirect
&
National Museums of Kenya, Ornithology Section

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Abstract

Chemical compounds particularly pesticides, are responsible for significant bird deaths worldwide often as the result of misuse and unintentional effects of chemicals, as well as the intentional control of bird intrusions such as the case of Quelea species in cereal fields. This study investigated the deliberated poisoning of birds using pesticides suspected to be the carbofuran based brand Furadan, for securing wild bird meat for human consumption in Bunyala irrigation Scheme in western Kenya. Our goal was to document what was happening on the ground and to quantify the observed casualties of birds and the impact on their conservation status. We used the opportunity in the field to educate members of the local community on the health and conservation implications of the practice of pesticide poisoning of birds for human consumption.

The field study was conducted between February and November 2009. We identified and counted dead birds directly hence raw bird carcass counts. Mortalities were expressed as a proportion of individuals of their populations exposed to Furadan. On each plot where poachers were laying bait, we identified and counted/estimated numbers that foraged in the plot. These constituted the exposed population for each of the observed species. Those that flew away were deducted from this number whereas those that flew in were added until the birds started getting intoxicated and poachers started collecting them. The dead were then expressed as a percentage of the exposed total number per species. Whole gut tissue samples were also obtained from some dead birds at the study site and tested at the Government Chemist's Division Laboratory for the presence of carbofuran. This was done to verify carbofuran ingestion and intoxication as the cause of mortality. Poachers and consumers of birds were also interviewed, first without having been educated, then after education about birds and implications of poisoning and consuming poisoned birds.

We found that the birds most adversely affected by pesticide poisoning were wetland species especially those that congregate. The species most frequently killed using pesticide poison was the African Openbill (*Anastomous lamelligerus*).

This report also makes recommendations and suggests mitigation measures to eliminate the practice of the pesticide poisoning of birds for human consumption. The study's findings demonstrate the urgent need for concerted efforts to address the derogatory practice of deliberately poisoning birds for meat at the study site. The recommendations call on the local pesticide regulation authorities, conservationists, the health sector, agricultural sector, wildlife sector and tourism sector to combine efforts if the situation has to be corrected ultimately.

Introduction

Kenya has the second highest avian diversity in Africa and the eleventh worldwide with a remarkable 1100+ bird species (Nature Kenya 2009; Mongabey 2010). This adds richness and value to the wildlife industry which is Kenya's giant source of foreign income. Markedly, wetlands are vital habitats for biodiversity utility, particularly birds. Man-made wetlands constitute acknowledged Important Bird Areas (IBAs). The Dandora Oxygenation ponds in Nairobi, Kenya for example are an internationally recognized IBA designated, KE IBA 35 (Bennun and Njoroge 1999). Irrigation fields likewise are important man-made wetlands where birds congregate to forage and water. Such is the case witnessed in a number of Kenya's rice growing plantation farms such as Bunyala Rice Irrigation Scheme. Reports made in the early 1990's and my own personal observations, found that wetland birds congregating in irrigation schemes were being hunted in large numbers, using pesticide poisons. This study set out to examine the extent of deliberate pesticide poisoning of birds in one irrigation scheme, the Bunyala Rice Scheme to document and quantify the extent of bird deaths and the conservation implications of this practice.

Background

Poisoning is a latent, efficient method of killing birds and other biodiversity at large. Pesticides are easily available and convenient for use in killing birds. Carbofuran is one such poison that scientists attribute massive bird mortalities to in USA and Canada. In Kenya carbofuran sold as the brand Furadan has been linked to lion deaths, vulture deaths and wetland bird mortality.

Birds' biodiversity is particularly vulnerable to pesticide poisoning. Birds may be the victims of direct poisoning for procurement of food and to eliminate pests or indirectly through incidental and accidental poisoning and through secondary poisoning after consumption of other animals that have been poisoned. The consumption of poisoned birds by other predators and scavengers can lead to further animal deaths thus having a cascading effect through the food chain.

Aim

To quantify the scale of deliberate pesticide poisoning to birds in Bunyala Rice Scheme Kenya, and assess the impact on bird conservation.

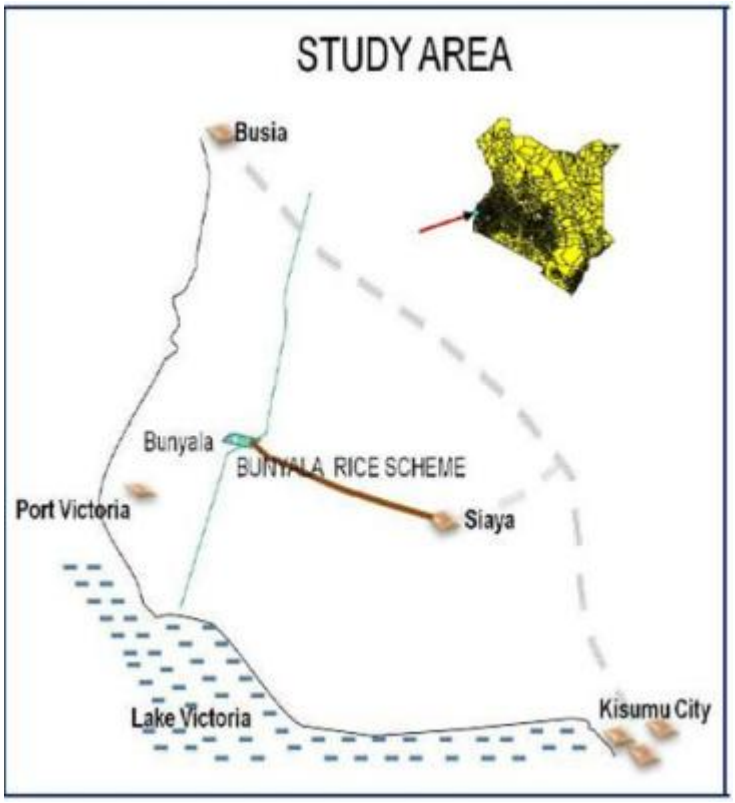
Specific objectives

1. To assess the mortality of birds resulting from deliberate pesticide baiting at the study area during the study time.
2. Provide evidence to authenticate bird poisoning using pesticides at the study site.
3. To educate local communities on the dangers of pesticide toxicity.
4. To inform government and NGO stakeholders of the outcomes of this study.

Methodology

Study site and study area

This project was conducted in Bunyala Rice Irrigation Scheme, approximate central coordinates 00°05.797´N, 034°03.658´E in Busia District, Western Kenya. The study area included 5km radius on the average about the focal point-the irrigation scheme. It was therefore possible to establish the extensiveness of the bird poisoning in Bunyala. The habitat is a dynamic man-made wetland; seasonally flooded (at cultivation time) and seasonally dry (at harvesting until the next cultivation time). The study site is about 1000ha of the main farmland and another 500ha of disjointed, smaller satellite farmlands. The map in **Appendix III** illustrates the distribution of poisoning in Bunyala (Magombe East and West). The map indicates that other than a few outlying points to the East and South, the main rice scheme was the major poisoning site.



Methods

Field work was conducted on site between February and November 2009

1. Stratified sampling survey

The large Bunyala rice plantation is subdivided into small rectangular plots which constituted the individual grids during the study. Each plot is defined by soil embankment and averages an area of 0.75 of an acre. Following opportunistic observation where pesticide poisoning was taking place, sampling was done in the respective grid. Bird species of relevance (i.e. targeted) were identified based on the bait used. The numbers of the identified targeted species were also recorded between the time the poachers put out the bait in the plot(s) and the time that they gathered the poisoned bird carcasses. In-flying individuals during the waiting time (duration when the poachers keep away from the quadrant where bait has been laid; passersby were also directed to keep off from the poisoning site) were added to the total already recorded. This constituted the observed sample for each of the species. The individuals that flew away during the waiting period as poachers waited for the birds to eat the poison bait were left as part of the observed sample as they were assumed to be possible intoxicated victims. Once the poachers had gathered their kill we requested to identified and record each species' mortality. In some cases we had to estimate from a distance to avoid unwelcoming poachers' aggression.

2. i. Questionnaires and interviews

We sought permission from locals and explained to them that we needed to know some facts about the bird poisoning industry for this study to be able to plan for education and also to deduce and suggest an alternative, productive project(s). Two kinds of questionnaire were then administered for different respondent groups:

a) Poacher/hunter questionnaire-This was administered to the persons that were poisoning birds to obtain information on the details of bird poisoning and to assess their attitudes.

b) Consumer questionnaire- This targeted the general public that were purchasing poisoned birds/carcasses from poachers.

There was also a repeat administration of the questionnaire targeting individuals not approached during the first phase to evaluate level of awareness and effect of our attempts at education. Additional information was also obtained mostly through informal question and answer sessions.

ii. Thin Layer Chromatography (TLC) analysis

Some bird carcasses were collected from the poisoning field while others were purchased from the poachers so as not to bias our samples for laboratory testing. The guts of were then eviscerated from the carcasses and stored in tissue jars. These were then kept in frozen ice in a cool box and transported to Nairobi. They were then analyzed for carbofuran by TLC at the Government Chemist Laboratory. A sample of the pesticide-laced rice bait/granules collected from the container that was used to carry the bait was also tested.

3. Education

This was employed to enhance local people's appreciation of birds and their knowledge about Furadan, the pesticide found earlier to be in use for poisoning birds. Two local scouts were trained on bird identification and the counting of poisoned birds inclusive of estimating the numbers of larger flocks. Other locals were also educated on the health implications of Furadan to humans and other biodiversity mainly through informal sessions. An opportunity always presented itself where a few individuals became interested in what the project was all about and in the end the gathering multitude were informed about the relevance of the whole project.

4. Periodic reporting and blogging

Monthly updates on bird poisoning at the study site were provided to the local pesticide regulation agency, the Pesticide Control Products Board (PCPB) between March and July. Further, an online advocacy tool was employed involving documenting the activities and the immediate findings of the project on the blog, http://stopwildlifepoisoning.wildlifedirect.org/. This was aimed at creating publicity and raise awareness to the general public. The technique was also a way of providing anecdotal information and seeking for the attention government pesticide regulation authorities on the issue of deliberate Furadan poisoning of birds at the study areas and other sites particularly rice irrigation schemes where there is a similar problem.

Results

The findings below were obtained during 10 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 were obtained by the two local assistants, though less rigorous, have also been included. The percentage mortality threat was not calculated for birds that were observed to have been collected by the poachers but whose initial live individual totals were not estimated. In most cases this occurred when there were large flocking numbers of mixed species. We documented all poisoned birds as individuals that were actually observed to be disoriented. In some cases birds were poisoned and then their wings and limbs dislocated so that the live but disoriented birds could be used as bait to attract other birds.

These birds were poisoned using different poisoned laced food items for bait. Snails, small fish and termites were laced with purple granules and powder made from grinding up the granules. Rice was soaked in a pesticide solution thought to be Furadan.

Figure 1. Pila fresh water snails laced with purple granules believed to be Furadan for poisoning storks

Results of bird mortality by pesticide poisoning

Overall, 3,186 birds were documented to have died from Furadan poisoning. This is out 8,659 individual birds observed to be visiting field plots of .75 ha in the irrigation scheme representing 36.8% mortality rate. Four Hundred and Fifty two individuals from a population of 1,005 individuals were palaearctic migrants. For this group, it represents 45% annual mortality of individuals that visit plots where poison laced baits are laid out. In addition, 2,734 intra-African migrant birds were killed by poisoning. This was out of 7,654 representing 35.7% mortality rate.

A total of 8659birds were exposed to poison and of these 3186 succumbed to the poison and died representing 36.8%. These represented 32 species in total. The analysis that follows examines the impact on Palearctic migrants – i.e. Birds that wintered in Africa from Europe e.g. Wood Sandpiper (*Tringa glareola*) and Black-tailed Godwit (*Limosa limosa*) and the Intra African migrants – birds that migrate within Africa which include Openbill, Abdim's Stork (*Ciconia abdimii*) and Glossy Ibis (*Plegadis falcinellus*).

Figure 2. Wood Sandpipers: Example of Palaearctic migrants poisoned using Furadan

Figure 3. Mixed species of doves: Example of resident species poisoned using Furadan

Two kinds of charts were plotted to portray comparative mortality within species (Mortality against Total numbers) and individual species losses (Percentage mortality rate)

Mortalities against total numbers observed for palaearctic migrating birds at the site between March 2009 and December 2009.

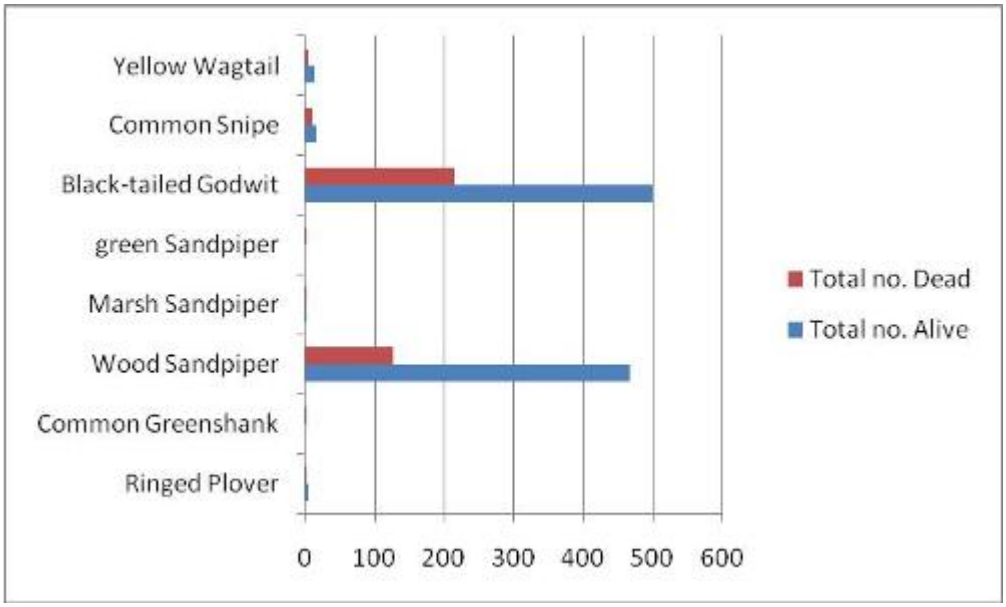


Figure 4. Results of observed Palaearctic migrant bird mortalities per quadrant (plot)

The highest mortality amongst Palearctic migrants was noted in the Black-tailed Godwits. 215 out of 500 individuals died from poisoning. The Wood Sandpipers were the second most poison-killed palaearctic bird where out of 467 individuals exposed to poisoning 126 died. The Green Sandpiper, Marsh Sandpiper, Common Greenshank and Ringed Plover were poisoned in comparatively smaller numbers (with less than 100 individuals exposed to the threat) being less common species. We conclude that the number of individuals killed by poisoning is directly proportional to the flock or group size of the species for Palearctic species.

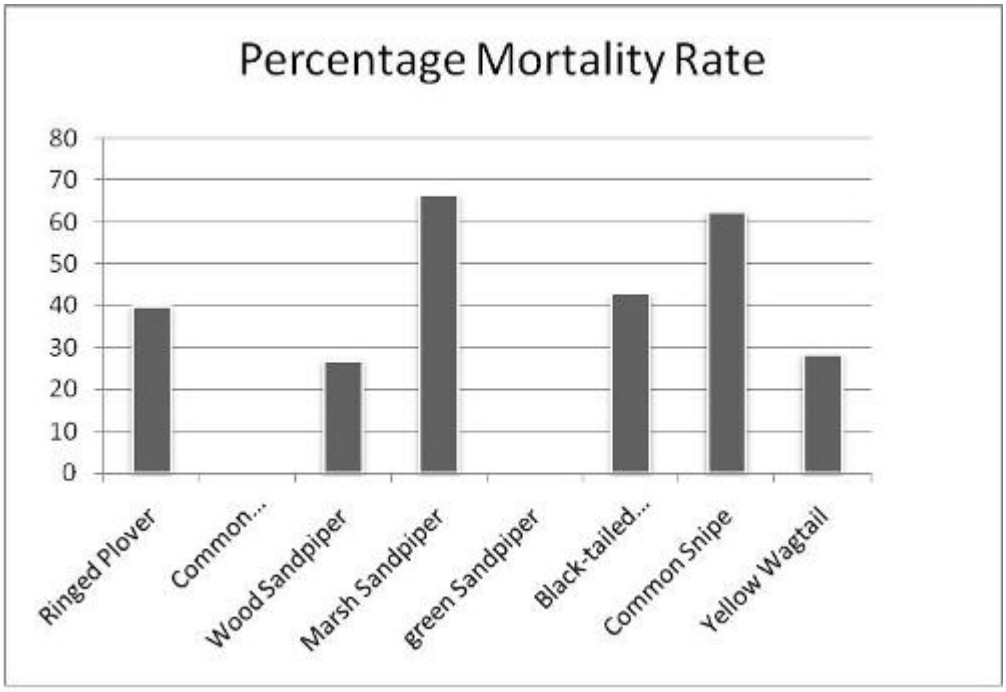


Figure 5. Poisoning threat mortality for the palaearctic birds (percentage of what exactly?)

From the bar chart above, mortality rate expressing percentage losses per species was highest in Marsh Sandpipers then regressively followed closely by the Common Snipe, Black-tailed Godwit, Ringed Plover, Yellow Wagtail and then Wood Sandpiper. Percentage mortality in this case is highest in less common (or abundant) species. The values from *Figure 4,* for example depict that the Wood Sandpiper was the second most killed species but has the least mortality rate in this chart.The Marsh Sandpiper's mortality had negligible mortality totals in *Figure 4* but has the highest mortality rate. We therefore conclude that mortality rate is highest in less common species.

Mortality against total numbers observed for Intra-African bird migration season are also summarized below.

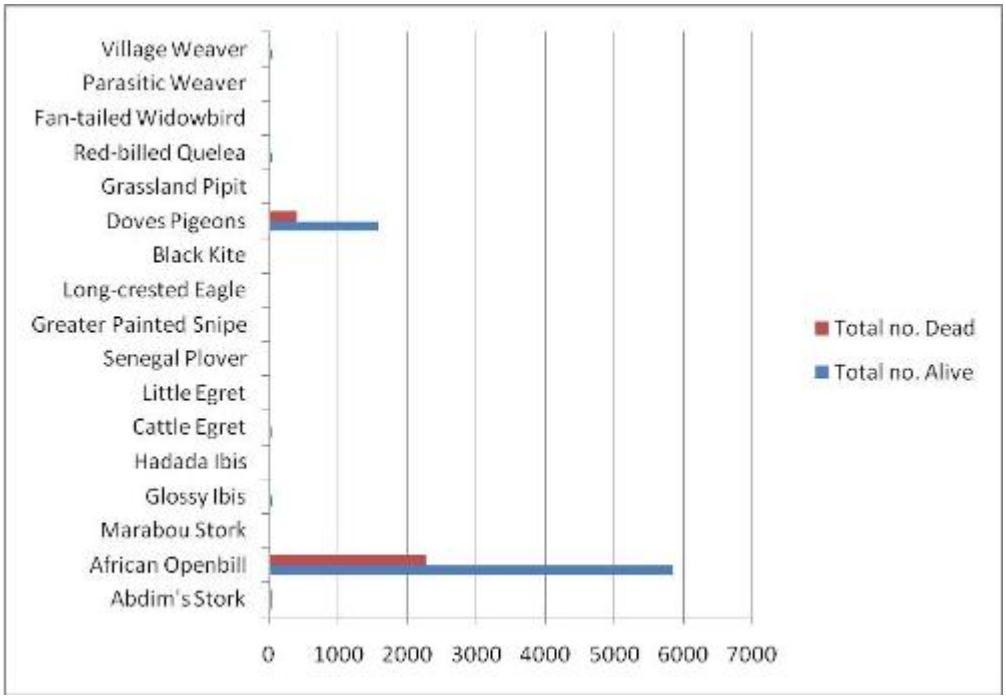


Figure 6. Results of observed resident and intra-African migrant bird mortalities per quadrant (plot)

The African Openbill was unproportionally the most poison-killed species of the resident and intra-African migrants. 2261 out of 5848 individuals exposed to poisoning died. In fact the Openbill suffered the highest mortality from poisoning overall accounting for 26.11% of all mortality observed at the site. Mixed species of doves and pigeons were the second most poisoned bird family with 391 out of 1570 dying from poisoning. These were lumped together because they associated closely and singling out individual species was difficult. The Abdim's Stork was the third most poisoned species while the rest followed regressively with mortalities of less than 10 individuals each. Again in this case for resident/intra-African migrant species, the most abundant species were the most poisoned which is consistent with the case of the Palearctic migrants.

The African Openbill was poisoned using a unique baiting technique employing live decoys with beaks fastened with a string or rubber band so that they do not eat the poison laced bait (*Pila* sp. snails) themselves and their feet were tied with a loose string to restrict their movement. The poachers then went around disturbing nearby flocks of Openbills which only had the option of settling around the decoys and bait otherwise the disturbance went on and on. This enhanced the intoxication of the species.

Figure 7. Live Openbill decoys and poisoned victims

The percentage mortality rate of each of the poisoned resident and intra-African migrant birds was worked out and plotted in the chart below.

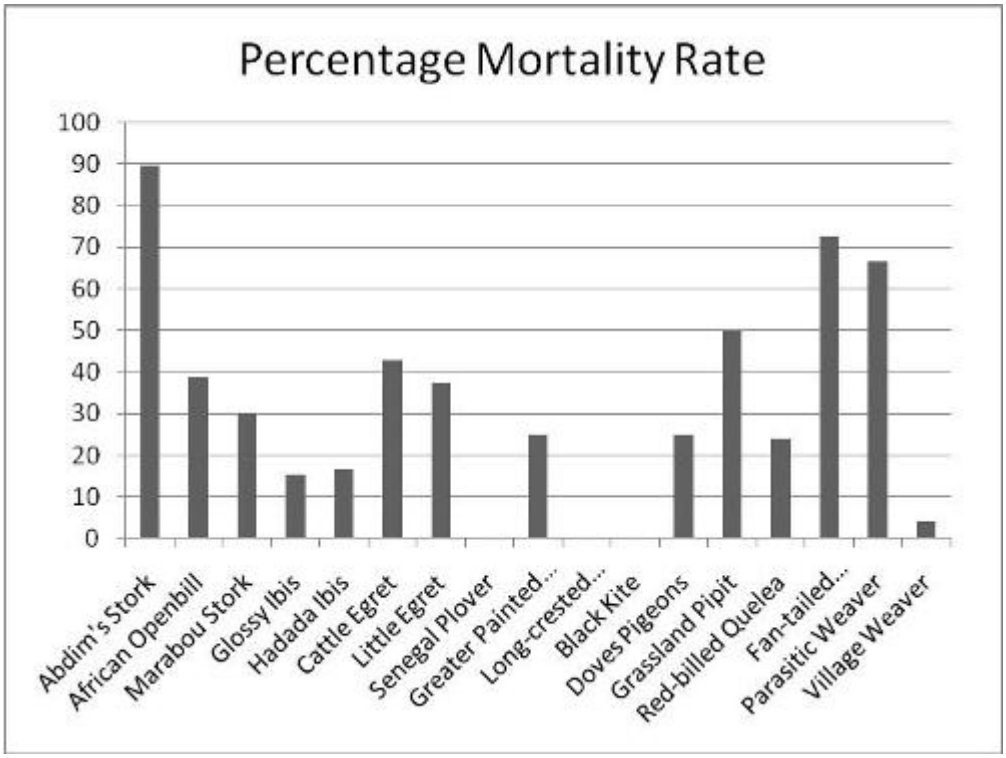


Figure 8. Poisoning threat mortality for resident/intra-African migrant birds

Abdim's Stork had the highest mortality followed by Fan-tailed Widowbird, Parasitic Weaver, Grassland Pipit, Cattle Egret, African Openbill, Little Egret, Marabou Stork, Greater Painted Snipe, Red-billed Queles, Hadada Ibis, Glossy Ibis and Village Weaver. Species which were less

abundant (*Figure 7*) dominated in having higher mortality rates; Only 8 Fan-tailed Widowbirds were poisoned out of 11 and their mortality is second highest at 72.72%. The African Openbill which had the highest mortality has a 38.66% mortality rate. Mortality in this case therefore is also highest in less common species.

Results of questionnaires and interviews

Thirteen questionnaires were administered to poachers (5 at the start of the study and 8 at about the end of the study) and two hundred and seven (62 at the start of the study and pre-education stage; 180 at about the end of the study) to consumers.

Poachers' responses

A total of 5 poachers were interviewed at the pre-education stage of the study and 8 at the end of the study. The latter interview/questionnaire stage obtained responses from 4 additional poachers while one of the poachers interviewed during the first stage quit poaching purportedly due to old age. Poachers hunted birds in teams and so the additional 4 poachers might simply have duplicated the wishes of the 4 already questioned poachers at the pre-education stage. Nonetheless these were interviewed to evaluate for any ideological differences amongst the teams.

All the 8 poachers had been poisoning birds for more than 5 years. Four of the 5 poachers were in their 30's while there was one between 60 and 70 years age. He quit bird poaching for herding during the study. All the 5 poachers also claimed they poached birds as their only source of income. All of the poachers named Furadan as the poison of choice. Two of the poachers indicated that they had attempted to use a granulated silvery compound that had replaced Furadan during July 2009. From their description we suspect that the pesticide was Mocap. The two stated that the compound was pungent and repelled rather than poisoned the birds. Further, the new pesticide gave them respiratory problems and was generally ineffective for poisoning birds.

All of the poachers stated that they were aware of Furadan's deadly toxicity. They claimed that washing their hands and slow drying of the bird carcasses prior to cooking detoxified carbofuran from the meat. However, during the second phase of interview after we had conducted some education, the poachers knew that Furadan affects the central nervous system. However, all still held on to the belief that heat detoxified carbofuran.

During the first phase of questionnaire administration, 3 of the poachers said their poaching frequency varied depending on need. They stated that they would poison daily, especially at rice planting season (varies depending on rains) and one specialist poacher who focused on poisoning doves and pigeons stated that he poached seasonally when there were many birds at the irrigation fields at harvesting of the rice at the irrigation scheme for about 2 months. At

other times he made a living as a self-trained electronics repairer. The fifth poacher said he poisoned birds daily.

Four of the 5 poachers stated that they poisoned the African Openbill as a priority but also waders and seedeaters if the Storks had become imprinted against the decoys. The fifth poacher focused on poisoning Doves and Pigeons but like the rest also poached waders and seedeaters. All 5 respondents used the same scale of pricing for the killed birds. The prices was greatest for the larger birds such as Openbill, and lower for waders and seedeaters (pigeons, doves, pipits, widowbirds, weavers) see table 1 below.

Species/family	**Phase I of interviews/questionnaires**		**Phase II of interviews/questionnaires**	
	Raw	**Dried/Roasted**	**Raw**	**Dried/Roasted**
African Openbill	Ksh. 50	Ksh. 70	Ksh. 80	Ksh. 100
Marabou stork	Ksh. 400		Ksh. 400	
Ibises & Egrets	Ksh. 40		Ksh. 40	
Pigeons/Doves	Ksh. 20	Ksh. 40	Ksh. 40	Ksh. 50
Sandpipers	Ksh. 10		Ksh. 20	
Widowbirds/weavers/pipits	Ksh. 5		Ksh. 10	

Table 1. Bird meat price list per individual unit

All the poachers in both phases of the interviews/questionnaire sold the bird meat to anyone who purchased the birds from them.

The price of Furadan escalated during the period of the study. During the first part of the study when the chemical was available it was estimated to cost 1.25 USD per 200 gm pack. At the end o the study the product was not easily available and the price had risen to 10 USD for the 200 grams pack which corresponded to hiked bird meat prices of preferred species above.

Consumers' responses

During the first phase of the questionnaires/interviews 2 respondents stated that they ate bird meat daily; one was a wife of a poacher and the other was a primary school class 6 child. 60 consumers responded that they purchased the meat opportunistically when the poachers/vendors came by with the meat or found it being sold at the local market. In the second phase, 112 respondents out of 180 still admitted to purchasing bird meat opportunistically whereas 68 did not answer the question on how frequently they consumed birds. None fed on poisoned bird meat because there was no other source of protein which was amongst the options provided when the consumer would consume bird meat .

In the first phase of questionnaires/interviews, 19 out of 62 of the consumers preferred bird meat to other source protein while in the second phase 29 out of 180 preferred bird meat to other source of protein. All the consumers were also aware that the birds were obtained from the wild by poisoning using Furadan but stated that draining fluids from the carcasses through roasting or overhanging the carcasses on glowing firewood ambers before cooking detoxified the poison from the meat. Nonetheless, they acknowledged that the pesticide being used, Furadan was deadly toxic.

The consumers stated that they ate the species in figure 6 above though not with absolute entirety listing of the birds. However, the African Openbill and the doves/pigeons were named by 219 out of the 242 consumers. It is also worth noting that while all the 62 respondents in the first interview phase gave their response to the question on which birds they consumed, 23 out of the 180 respondents in the second phase, did not give their response to this question. The pricing matched that in figure 6 above.

The consumers reported that they had no particular bird meat supplier but could obtain birds by placing an order with any of the poachers to supply them with bird meat.

Results on Thin Layer Chromatography Analysis

Carbofuran (Furadan) a carbamate was detected in the sample labeled 'BAIT' which was collected from what was left in one of the poacher's jar containing bait for killing birds. 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.

Impact of education and awareness on Furadan poisoning

Education as a tool was directed towards empowering locals in the project and also used to change their perspective about poisoning and eating intoxicated birds. Two local assistants were trained. They continue to be involved in monitoring for poisoning and recruiting other individuals to join the local bird watching team then advocating against bird poisoning. The PI and PA also conducted informal awareness creation sessions with poachers and consumers

alike. They were however confronted by the problem of *priori* knowledge by the locals that consuming Furadan-poisoned birds is not harmful to humans. Yet again they the locals acknowledged that Furadan is deadly toxic to biodiversity. There were no human mortality cases that could be directly linked to pesticide poisoning thus, the locals were not appreciably convinced that consuming birds killed by Furadan was significantly harmful to them.

Poachers were also persuaded to change to vegetable farming and utilize the abundant water resource from River Nzoia and also receding waters of the customary annual floods in the area. This was after enumerating the advantages of farming over poaching.

Figure 10. Poachers being educated about birds and their values

The regular blogging on Wildlifedirect platform at http://stopwildlfepoisoning.wildlifedirect.org/ (and http://baraza.wildlifedirect.org/) on the study's progressive findings and also other biodiversity poisoning incidences contributed towards the withdrawal of Furadan by the US core manufacturer, Farm Machinery and Chemicals (FMC). Kenyan's unutilized Furadan supply was retrieved through a buy back programme that commenced in May 2009 and hitherto the pesticide is scanty in most Agrovets though not unavailable. In addition, monthly updates on Furadan associated bird mortality at the study site were availed to other stakeholders namely the Kenya Wildlife Service, the Nature Kenya (Birdlife International's local partner), Crop Life Kenya (Agrochemicals Association of Kenya-AAK) and the local pesticide regulation body, Pesticide Control Products Board (PCPB). Currently talks between conservationists, particularly Wildlifedirect and PCPB following government ministerial (Agriculture) directive to look into the case are underway in an attempt to better regulate Furadan and other deadly pesticides.

Discussion

A significant proportion of birds that visited plots where pesticide laced baits were placed were killed; 36% of all birds that visited the plots where pesticide laced baits were left in the irrigation scheme were killed. At these rates, populations of a number of species are at risk of being decimated. The Black-tailed Godwit for example is listed as Near Threatened (IUCN 2009). With the study site is located on a major migratory flyway, it means repetitive down cutting on their numbers. Wetland birds are the most affected primary victims of deliberate poisoning including storks, egrets and waders. Grassland birds and raptors also suffered because they are seedeaters and predators respectively attracted by their food resources concentrated at the rice irrigation plantation. Only frugivorous birds were not affected at this study site.

We observed that generally, flocking birds were the primary target for pesticide hunting at the study site and constituted 87.5% (28 out of 32) of all poisoned species. Four species of non-flocking birds were also casualties of poisoning - Long Crested Eagle, Black Kite, Yellow-throated Longclaw and Grassland Pipit. The African Openbill, doves/pigeons, Black-tailed Godwit and Wood Sandpipers were the most frequently killed species.

Occurrence (seasonality) status also determined intensity of poaching and therefore level of mortality. Overall, higher mortality was recorded for resident species. The African Openbill (African Open-billed Stork) suffered 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 could have over time made the Openbill the bird of choice amongst poachers and also consumers. Considering Its size, the Openbill stork is relatively cheap which may reflect greater availability than other species.

Most other resident and intra-African birds are seasonal in abundance - being attracted to the irrigation scheme only when there is crop. This was particularly so for the doves and pigeons which only flocked at the irrigation scheme at harvest time. The palaearctic migrants are likewise seasonally occurring only when it is winter time in their breeding grounds in the northern tropics.

Certain palaearctic migrants however are at great risk of poisoning despite the short duration of their seasonal occurrence. Incoming palaearctic migrants are particularly vulnerable because they arrive hungry and will gorge themselves at the Bunyala stopover site. The Black-tailed Godwit suffered very high mortality rates of 43% after feeding on laced bait. The migrant was was only observed to be present 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 lasting till May) when it probably utilizes 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 are particularly easy to poison with pesticides. For example the Abdim's Stork was observed to be easily directed towards the bait and continued consuming poison-laced bait even if some of their exposed individuals got disoriented. In contrast, the Open-billed Stork would be alerted by their flock members getting intoxicated and it sometimes took repeated baiting sessions to kill them.

Toxicological assessments of baits and tissues from dead birds confirmed the presence of carbofuran. Carbofuran is the active ingredient in Furadan, the pesticide that the local poachers admitted to be using to poison birds.

Cultural practices and beliefs have entrenched the practice of poisoning birds in Bunyala. The questionnaires and interviews revealed that Furadan was the pesticide of choice and may still be in use at the study site. 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 bird meat to other sources of meat, stating that wild meat is tastier and most nutritious. This motive to consume birds that had been killed with pesticides was so strong that it over rides knowledge about the dangers of pesticide poisoning from the meat. The market for poached meat was large and was responsible for creating a demand that drives the poaching.

We documented a general lack of awareness regarding risks of human pesticide poisoning as a result of poaching and consuming intoxicated bird meat. Most consumers and poachers believed that the meat was safe. A poacher's wife who claimed she ate poached bird meat every day died early this year (2010) from unknown causes and possibly pesticide poisoning. During the interview, she had been nursing knee joint paralysis and was using a walking stick.

If left unchecked, bird poisoning in Bunyala will have significant impacts on local and migratory birds and may have already wiped out ducks. Bird poisoning at Bunyala has been going on for decades or longer and early studies indicated that initially wild ducks were mainly targeted. These include the Whistling Ducks (J. Achieno pers. comm.). Presently, very few of the ducks remain at the site and on many surveys none were observed (M. Odino pers. obsv). Indeed in the other irrigation schemes where there were also surveys on bird poisoning in Ahero and Mwea Irrigation Schemes, Ducks were the observed preferred birds. We suspect that the poisoning of Wattled starlings may have reduced the population to very small numbers as large flocks of this species which were commonly seen with cattle in the past, are no longer being sighted.

Conclusion

This study concludes that the very high rate of poisoning of birds in Bunyala rice irrigation scheme is due primarily to the demand for wild bird meat by the local population. The preferred method of procuring this meat is through the use of the agricultural pesticide Furadan which is an extremely cheap and efficient means of killing birds. The practice of bird hunting in this scheme poses a double threat in Kenya and Kenyans. First, important bird populations are at risk and populations of at least two species have been significantly affected. Secondly, the regular consumption of bird meat that has been procured using pesticides exposes consumers to potentially lethal concentrations of pesticides.

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 (May to November 2009) the availability of Furadan's was limited following its withdrawal from Kenya by the manufacturer FMC. We therefore conclude that the mortality figures obtained are lower than for previous years when the product was widely available.

The practice of consuming wild meat is cultural and is not linked to the lack of alternative protein in Bunyala. The practice has become a habit cultured by the belief that wild meat is best, especially when cheap. Local inhabitants of Bunyala are averagely successful domestic animal farmers who keep livestock and chicken in modest numbers.

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.

Recommendations

1. Pesticide regulation authorities need to step up Furadan's (and other pesticides) regulation and if the situation is out of control proceed on to barn it. While Furadan is withdrawn from the Kenyan market for poisoning abuse reasons, poachers at the study site are still able to secure it. They claim they purchase it from Uganda. No farmer has been reported to have purchased it from outside Kenya for farming purposes since the legal supplier and manufacturer, FMC pulled off their continued supply. The problem therefore not only lies with the abuser but also with a legislation that is inadequate and ineffective. It is clear therefore that the pesticide is intended for abuse rather than its proper reason which is currently negatively impacting on Kenyan birds and biodiversity.

2. The national and international bird conservation authorities should consider upgrading the status of the irrigation scheme for conservation and even foreign exchange (tourism) gains. This can be structured in such a way so as not to hinder on-going cultivation exercise. For instance construction of an observatory for bird watching. If properly implemented, so that benefits get to the local community as well, this would boost local appreciation of birds which would promote their conservation.

3. The medical experts need to bridge the gap of ignorance by participating in sampling and testing humans at the study site to shed more light on the adversity of the toxicity problem from consuming intoxicated meat.

4. The Ministry of Agriculture through its extension officers should assist locals at the site to venture into vegetable farming besides guiding them on safe pesticide use. This will boost agricultural productivity in the area whose status quo is unstable while at the same time educate the locals against abusing pesticides.

5. There is need to investigate on the component of intoxicated birds that fly away only to die elsewhere in order to obtain a more accurate measure of the effect of Furadan poisoning on the community of birds.

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Appendices

Appendix I

Questionnaires

Bird hunter/poacher questionnaire

Administered by Martin Odino and Joseph Achieno

Contacts: +254722447715, **email:**martinchael@gmail.com

NB. *We guarantee participant confidentiality and this information will be used strictly for research purposes*

Participant's name: _____ (optional)

Participant's age: _____ (optional)

1. For how long have you been poisoning birds?

(a) I year (b) 2-5 years (c) More than 5 years

2. i. Why do you poison birds?

   (a) It is my only source of income

   (b) It is our only source of protein

   (c) I do it as a hobby

   ii. Which chemical substance(s) do you use? Are you aware that Furadan is deadly toxic? Based on your knowledge, what are the ill effects of Furadan?

3. How frequently do you poison birds?

   (a) Daily (b) When there are many birds at the irrigation scheme (c) Other (explain)

4. Which bird species do you poison and at what unit prices?

5. Who are your customers?

Consumer questionnaire

Administered by Martin Odino and Joseph Achieno

Contacts: +254722447715, **email:**martinchael@gmail.com

NB. *We guarantee participant confidentiality and this information will be used strictly for research purposes*

Participant's name: _____ (optional)

Participant's age: _____ (optional)

1. How frequently do you eat birds on the average?

   (b) Everyday (b) When there is no other source of protein (c) When the poacher supplies

2. i. Do you prefer bird meat to other kinds of meat?

   (a) Yes (b) No

   ii. Do you know how birds are locally obtained from the wild? Are you aware that Furadan is deadly toxic? Based on your knowledge what are the ill effects of Furadan?

3. Which bird species are consumed locally and at what unit prices are they sold?

4. Do you have a regular supplier of bird meat? Please explain

Appendix II

List of poisoned birds

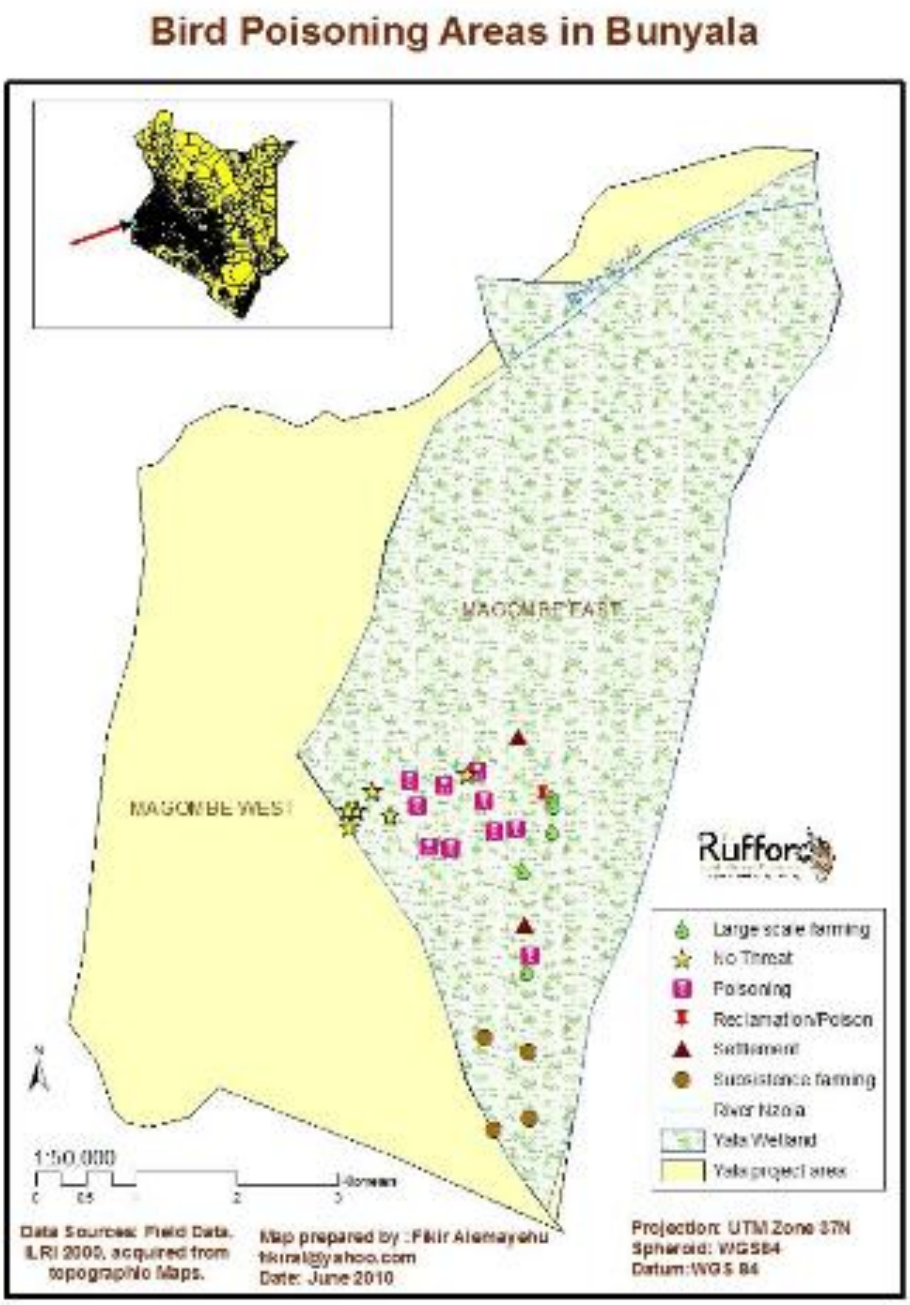
Species observed	Scientific Name	No. Alive	No. Dead	Percentage mortality
Abdim's Stork	*Ciconia abdimii*	29	26	89.69
African Openbill	*Anastomous l.*	5848	2261	38.66
Marabou Stork	*Leptoptilos crumeniferus*	10	3	30
Glossy Ibis	*Plegadis f. falcinellus*	39	6	15.38
Hadada Ibis	*Brastrychia hagedash*	6	1	16.67
Cattle Egret	*Bubulcus i. ibis*	21	9	42.86
Little Egret	*Egretta g. garzetta*	8	3	37.5
*Senegal Plover	*Vanellus tectus*		4	
Ringed Plover	*Charadrius hiaticula*	5	2	40
Common Greenshank	*Tringa nebularia*		2	
Wood Sandpiper	*Tringa glareola*	467	126	26.98
Marsh Sandpiper	*Tringa stagnatilis*	3	2	66.67
*Green Sandpiper	*Tringa Ochropus*		1	
Black-tailed Godwit	*Limosa l. limosa*	500	215	43
Greater Painted-Snipe	*Rostratula b.*	4	1	25
Common Snipe	*Gallinago g. gallinago*	16	10	62.5
*Long-crested Eagle	*Lophaetus occipitalis*		2	
*Black Kite	*Milvus m. migrans*		1	
Dusky Turtle-Dove	*Streptopelia l. lugens*			
Ring-necked Dove	*Streptopelia capicola*			
African Mourning Dove	*Streptopelia d.*			
Red-eyed Dove	*Streptopelia*			
Speckled Pigeon	*Columba g. guinea*			
(doves/pigeons)	Refer above	1570	391	24.90
*Yellow-throated Longclaw	*Macronyx croceus*		1	
Yellow Wagtail	*Motacilla flava*	14	4	28.57
Grassland Pipit	*Anthus cinnamomeus*	2	1	50
*Wattled Starling	*Creatophora cinerea*		2	
Red-billed Quelea	*Quelea quelea aethiopica*	50	12	24
Fan-tailed Widowbird	*Euplectes axillaris*	11	8	72.72
*Southern Red bishop	*Euplectes orix nigrifrons*		3	
Parasitic Weaver	*Anomalospiza imberbis*	6	4	66.67
Village Weaver	*Ploceus cucullatus*	50	2	4

Key

Palaearctic migrants	
	Observed during in-coming and return migration
	Observed during in-coming migration
	Observed during return migration
Local species	
	Resident
	Intra-African/sites migrants
*	Species whose initial live individuals were not observed

Appendix III

Map of Study Area showing bird poisoning concentration around Bunyala Rice Irrigation Scheme



Appendix IV

Test Samples Results by Government Chemist Department

MINISTRY OF PUBLIC HEALTH AND SANITATION

Telephone: +254-20-2725806/7
and +254-20-2725873/9 (four lines)
Fax: +254-20-271756?
E-mail: govchem@wananchi.com
govchem@health.go.ke
When replying please quote

GOVERNMENT CHEMIST'S DIVISION
P.O. Box 20753-00202, KNH
NAIROBI

Ref. No. P/Vet/Vol. 1/09/(44) and date 16th June 20 09

CERTIFICATE OF ANALYSIS

Lab. Sample No: VT 18/09-23/09

Sender's Reference:

Sender:
Martin Odino
P.O Box 40658
NAIROBI

Date Received:
26th May 2009

Description of Sample:
i) Five (5) gut extracts from suspect poisoned bird (red eyed doves) labelled sample 1,2,3,7 and 8 respectively.
ii) Purple crystals in a urine bottle labelled 'BAIT'

Examination Required: Carbofuran screen.

Analytical Report:

Carbofuran (Furadan) a carbamate was detected in the "BAIT" and in the gut samples 1, 2, 3, and 7.Carbamate pesticides are poisonous and may be harmful to avians when ingested.

No other chemically toxic substances were detected in the 'GUT' samples.

Date: 16th June 2009

J. M. WELIMO

FOR: GOVERNMENT CHEMIST

JMW/ftr

Appendix V

UPDATES TO STAKEHOLDERS

INCIDENT REPORT OF POISONING OF BIRDS IN BUNYALA

Find below two poisoning incident reports for March-April 2009 and April-May 2009 in Bunyala, Busia District at the Bunyala Rice Scheme. The birds were intentionally poisoned using food bait (snails, termites and rice) laced with Furadan. The birds are then sold for human consumption to the local community, the poisoning being ongoing. I have attached accompanying photos.

Please note that under the Threat I have mentioned birds that were seen in the vicinity during the poisoning and the birds eat the same bait. However, being shy by habit may wait till the poisoning by the poachers is complete, then come in to forage on remaining bait in the field. Sometimes the birds that get poisoned this way are retrieved hours or days after if the locals coming to collect such do not stumble on them. Humans in addition are also included under threat, being the consumers of the Furadan-killed birds.

Kindly survey the Bunyala Rice Scheme site to witness the on-going poisoning using Furadan 5G.

MARCH - APRIL, 2009

Incident: Poisoning of waterbirds; migrants were notably most casualties as they were in season: Wood Sandpipers, Marsh Sandpipers, Green Sandpipers and Ruffs
Date incident occurred: 27/03/2009
Threat: Other than the waterbirds, the birds of prey that feed on the intoxicated birds: Lesser Kestrels, Eurasian Marsh Harrier and Black-Shouldered Kite; humans feeding on the poisoned birds.
Methods: Rice grains laced in Furadan

Incident: Poisoning of wetland birds [waterbirds and ecotone (Water-land intermediate or marsh) birds]: African Open-billed Storks, Common Sandpipers, Yellow Wagtails, Cattle Egret, Ringed Plover. Also a black Kite found apparently having died after eating a poison-killed bird.
Date of incident: 28/03/2009
Threat: Birds of prey: Black-Chested Snake Eagle. Also other storks- Abdim's Storks
Method:
1. Snail bait laced in Furadan and captive open-billed Storks to lure others to the poison bait. This is used in the capture mostly of the storks.
2. Termites laced in Furadan

Incident: Poisoning of Abdim's Stork
Date of incident: 29/03/2009
Threat: Grassland birds: Grassland Pipits; **Ecotone birds**: Spur-winged Plover, Little Egret, Red-throated Pipit; Birds of prey: Lesser Kestrels, Greater Kestrels.
Method:
1. Snail bait laced in Furadan and live open-billed stork decoys to lure other birds.
2. Termites laced in Furadan.

Incident: Poisoning of wetland birds: Yellow Wagtails, Wood sandpipers and African Open-billed Storks
Date of ncident: 30/03/2009
Threat: Grassland birds: Grassland pipit, Senegal Plover, Yellow-throated Longclaw; Wetland birds: Common Greenshank, Common Snipe, Green Sandpiper; Birds of Prey: Black-chested Snake Eagle, Lesser Kestrel, Grater Kestrel.
Method:
1. Snail bait laced inn Furadan
2. Termites laced in Furadan

APRIL - MAY 2009

Incident: No poisoning witnessed but children seen collecting pigeons (1 speckled pigeon) and doves (1 African Mourning Dove) which had died from poisoning a few days back.
Date of Poisoning: a few days before 25/04/2009
Threat: Seedeaters: African Mourning Doves, Red-eyed Dove, Fan-tailed Widowbird, Black-headed Weaver, Comb Ducks; Birds of prey: Long-crested Eagle
Method: From species seen to have been poisoned, the method used was Rice grains soaked in Furadan solution**.**

Incident: Poisoning of African Open-billed Storks, Speckled Pigeons and Doves
Date of Poisoning: 26/04/2009
Threat: The species above - African Open-billed Stork; Seedeaters: Black-headed Weaver, Jackson's Golden-backed Weaver, Southern Red Bishop, Fan-tailed Widowbird, Red-billed Firefinch, Red-cheeked Cordon-Bleu; Birds of prey: African Marsh Harrier
Method: Snail bait laced in Furadan and Open-billed Storks decoys.

Incident: Poisoning of African Open-billed Stork
Date of poisoning: 27/04/2009

Threat: As above.
Method: Snails laced in Furadan and live Open-billedStork decoys.

Incident: Poisoning of African Open-billed Storks and Speckled Pigeons
Date of poisoning: 29/04/2009
Threat: African Open-billed Storks; Seedeaters: Black-headed Weaver, Yellow-backed Weaver, Seckled Pigeon, African Mourning Dove, Red-eyed Doves, Laughing Doves, Spur-winged Geese, Comb Ducks, Egyptian Geese, Bronze Mannikin; Birds of prey: Black-shouldered Kite.
Method:
1. Snail laced in Furadan and live stork decoys.
2 Rice grains soaked in Furadan solution.

Incident: Poisoning of African Open-billed Storks
Date of incident: 30/05/2009
Threat: African Open-billed Storks
Method: Snail laced in Furadan and live stork decoys.

Incident: Poisoning of African Open-billed Storks, Hadada Ibis, Pigeons (Speckled Pigeons) , Doves (African Mourning Dove, Red-eyed) and Weaver birds(Black-headed Weavers).
Date of Incident: 01/05/2009
Threat: Other than above mentioned, Seedeaters: Yellow-throated Longclaw, Grassland Pipit, Yellow-backed Weaver, Egyptian Geese; Ecotone birds: Sandpipers, Crowned Plover, Little Egret; Birds of Prey: Black-chested Snake-Eagle.
Method:
1. Termites laced in Furadan & live Open-billed Stork decoys.
2. Snail bait laced in Furadan and live Open-billed decoys.
3. Furadan solution soaked rice bait.

Incident: Poisoning of Doves (African Mourning Dove, Red-eyed Dove), Pigeons (speckled pigeons) and Weaver birds (Black-headed Weaver).
Date of incident: 02/04/2009
Threat: Seedeaters: Southern Red Bishop, Black-headed Weaver, Yellow-throated Longclaw, Parasitic Weaver, Red-billed Firefinch, Fan-tailed Widowbirds, Bronze Mannikin, Egyptian Goose, Comb duck;Birds of prey: Eurasian Marsh Harrier, Black-Chested Snake Eagle, Gymnogene.
Method: Furadan-laced Rice bait**.**

Incident: Poisoning of Speckled Pigeons, African Mourning Doves and Red-eyed Doves.
Date of incident: 04/05/2009

Threat: Seedeaters: Pigeons and Doves; Fan-tailed Widowbird, Black-headed Weavers, yellow-backed Weaver.
Method: Furadan-laced Rice.

INCIDENT REPORT OF POISONING OF BIRDS IN BUNYALA (JUNE 2009)

Please find below a report of witnessed bird poisoning from Bunyala, Busia in June 2009. I wish to bring to your attention that between June and July (2009) I have been Ahero Rice Scheme and Mwea Rice Schemes where witnesses say there is ongoing poisoning of birds using Furadan. In Mwea and Ahero, the species of birds poisoned are the White-faced Whistling Ducks and Fulvous Whistling Ducks in addition to doves in Ahero. In all the sites the birds were intentionally poisoned for human consumption.

Please also find attached photos taken during June 2009 survey of the poachers with the poisoned birds in sacks and about them; also a photo of a torn off Furadan label by the poachers to conceal the identity of the Furadan poison they are using.

We also had some dove samples whose contents (gut-crop, gizzard and intestinal- contents) tested for carbofuran poisoning as well as the sampple of the bait that was used to poison them tested for carbofuran and I have also attached the certificate of analysis.

BUNYALA POISONING

Incident: Poisoning of Cattle Egrets (8 birds)
Date incident occurred: 04/06/2009
Threat: 3 species of Egrets(Cattle Egrets, Yellow-billed Egrets and Little Egrets), Hadada Ibis, Sacred ibis, Sandpipers and humans that handle the furadan and those that feed on the poisoned birds.
Method: termites and small fish laced in Furadan

Incident: Poisoning of African Open-billed storks (22 birds)
Date incident occurred: 06/06/2009
Threat: Humans that use Furadan for poisoning and those that consume the birds.
Method: Snails (Species Pila ovata) laced in Furadan

Incident: Poisoning of Cattle Egrets (4 birds)
Date incident occurred: 06/06/2009
Threat: Other Egrets (Yellow-billed Egrets and Little Egrets), Sacred Ibises and Hadada Ibises. Humans that use Furadan for poisoning and those that consume the birds.
Method: termites and small fish laced in Furadan.

Appendix IV

Some notes about Furadan

Furadan is the trade name of the compound by the core manufacturing company, Farm Machinery and Chemicals (FMC) while several others also market it as Curater (Wikipedia 2010). It is an N-methyl carbamate insecticide and nematicide. Carbamates are a group of organic compounds derived from carbamic acid. They are neurotoxic, inactivating the enzyme acetylcholinesterase (Wikipedia 2010) and interfering with normal nervous functioning. While oral intake is deadly, they can also be absorbed through the skin (New Jersey Department of Environmental Protection 2010; Wikipedia 2010) which makes them ideal insecticides. Furadan's deadly neurotoxic agent is Carbofuran hence also known by that name.

The precise brand marketed in Kenya is **Furadan 5g** and is granular in form**.** Furadan has been successfully used to control insects in a wide variety of crops like potatoes, corn and soya beans around the world (Wikipedia 2010). In Kenya its agricultural application has particularly been witnessed in its intensive use in commercial plantations notably rice irrigation fields and flower farms (Odino and Ogada 2008). It is also documented to be very toxic to birds and a single grain of Furadan will kill a bird (Minneau 1993). It kills small birds such as finches within a minute of ingestion of Furadan laced grain (M. Odino pers obs.). It will also kill the larger African Openbill (*Anastomus lamelligerus*) within an hour or cause disorientation within fifteen minutes for up to half a day if the subject does not ingest an amount equal to or more than the lethal intoxication dose (M. Odino pers obsv.). The pesticide is therefore exploited by poachers at the study site who poison the birds to supply the locals with intoxicated wild bird meat. This practice has particularly been observed in and around Kenya's large scale rice growing schemes in Bunyala, Ahero and Mwea (http://stopwildlifepoisoning.wildlifedirect.org/). The locals in Bunyala deem the meat safe for consumption after the carcasses' body fluids are drained using a traditional method involving slow heating of overhanging carcasses (M. Odino pers obsv.). Yet Furadan is lethal when directly ingested with a recent (November 2009) documented local incident of a 3 year old child's death in Kitale, Kenya after ingesting grains of the pesticide (Maina 2009). Furadan is also potentially cancerous and has been shown to cause birth defects or reproduction problems in laboratory animals (New Jersey Department of Environmental Protection, 2010)

Furadan as a class I compound calls for highly restricted handling (Odino and Ogada, 2007). The pesticide has however been easily accessible across the counter to any user up to as recent as 2009 for all the three decades that it has been available in Kenya. In surveys in 2007 and 2008 in Kenya it was established that Furadan's vast stocks were more abused as poison than properly used (Odino and Ogada 2008). Large commercial farms acted as avenues for the pesticides to easily reach individuals who abused Furadan for vermin control against rodents, carnivore predators (ions, leopards and hyenas), wild herbivores straying on to livestock pastures and for poisoning birds for wild bird meat (Odino and Ogada 2008). Presently it is presumed scarcely available in Kenyan agrovets though there are cases where it is still sold secretly and kept under low profile following withdrawal and buy back by FMC during 2009. This has erroneously been locally branded a 'ban'of the pesticide from Kenya and East Africa. At the study site in Bunyala, the poison is still evidently available as was established during a random survey of the area for bird poisoning in May 2010 (M. Odino pers obs.).

Controversially, poison baiting of birds, intended or unintended using Furadan has been empirically observed to trigger a chain reaction of faunal deaths through suspected secondary, even tertiary intoxication to other biodiversity higher in the food pyramid (J. Achieno pers comm.; http://www.maratriangle.org/; Minneau *et al.,* 1999). The result is that carnivores and scavengers have also been lumped in this insidious biodiversity killing exercise. These may however also be directly targeted in an attempt to control and avenge for livestock losses to the wild cats by the offended pastoralists (http://baraza.wildlifedirect.org/; http://lionguardians.wildlifedirect.org/; http://stopwildlifepoisoning.wildliferect.org/). This in turn has resulted in catastrophic losses of non-targeted vultures. During the 2000's, hundreds of vultures were poisoned in the Athi-Kapiti plains of Kenya (http://sthomsett.wildlifedirect.org/). The vultures fed on cow carcasses laced with Furadan intended for lions that had attacked pastoralists' livestock. Indeed Kenyan vultures (also worldwide) are dwindling in numbers and it is hypothesized that poisoning is to blame (Ogada *et al.* 2010).