

FRONTLINE SMS AS AN EARLY WARNING NETWORK FOR HUMAN-WILDLIFE MITIGATION: LESSONS LEARNED FROM TESTS CONDUCTED IN MOZAMBIQUE AND ZIMBABWE

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ABSTRACT

Human-wildlife conflicts (HWCs) have drastically increased around conservation areas in Africa in recent decades, thus undermining the peaceful cohabitation of wildlife populations and rural human settlements. Mitigation packages include HWC reporting, which is often ineffective since the information conveyed is generally scattered and useless. The booming mobile phone sector and the popular use of text messages (SMS) have provided an opportunity to assess the impact of real-time communication systems in HWC mitigation strategies. This paper presents the results of preliminary tests conducted in Mozambique and Zimbabwe with FrontlineSMS, a mobile data collection system. With sets of 52 wildlife playing cards, any wildlife events from patrol reports to HWCs were easily translated into explanatory variables listed on forms. Sending written information as text messages was hampered by IT problems linked with the use of commercial 3G USB modems. The overall system could be improved by using GPRS modems allowing a higher SMS flow and, at the informant level, by introducing ad-hoc SMS models to facilitate data capture on mobile phones. Once adopted, HWC early warning systems could be deployed at low cost.

Keywords

Human wildlife conflicts, mitigation, real-time report, FrontlineSMS, Mozambique, Zimbabwe

1. INTRODUCTION

Human-wildlife conflicts (HWCs) have drastically increased around conservation areas in Africa in recent decades. The underlying causes are similar across regions and can usually be attributed to land-use changes and high human population growth (Woodroffe et al. 2005). This situation is undermining the peaceful cohabitation of wildlife populations and rural human settlements in Africa (FAO 2009). For emblematic species such as elephants, conflicts with human neighbouring communities are a major constraint for the sustainable management and conservation of free ranging wildlife populations (Hoare 2001, Lee and Graham 2006). Since the 1990s, mitigation measures and HWC management strategies (WWF 2005, FAO 2009), with a focus on human-elephant conflicts (HEC) (Hoare 2012), have been widely developed. They offer a range of solutions based on gaining greater insight into the behaviour of problematic animals, testing various deterrent measures and adopting policies to reduce the extent of conflicts.

Reporting and assessing the local impact of HWC is part of this mitigation package, with the development of a decision support system and forms to be filled (WWF 2005), with a

specific design for HEC (Hoare 2002, Osborn and Parker 2002). In practice, the effectiveness of the reporting to decision-maker is problematic due to the provision of scattered and useless information. In Mozambique and Zimbabwe, the reporting of HWC incidents is poor, but also perceived as an ineffective exercise because of the wildlife authority intervention delay (Le Bel et al. 2011). In this setting, the trend is generally not to understand the problem, but rather to get rid of it with lethal methods, i.e. killing the problematic animals relieves the HWC stress and provides free meat for the community (Chomba et al. 2012) even though this shortcut does not overcome the problem (Hoare 2001).

Mobile phones were recently tested for HEC mitigation in the vicinity of Laikipia, Kenya (Graham et al. 2011), thus opening a new area for improvement based on an assessment of the impact of real-time communication systems, which are now an integral 'touch point' in most Africans' lives. Since 2000, this booming sector has grown by 44% in terms of the number of connections in sub-Saharan Africa (SSA), as compared to an average of 34% for developing regions and 10% for developed regions overall. There are currently more than 454 million connections in SSA and this trend is expected to continue growing from 60% in 2012 to reach 75% of the population and 700 million connections in 2016 (Vital Wawe Consulting 2009).

From simple reminders for vaccinations to grassroots information gathering on diseases, mobile phones are becoming a key cornerstone of health programmes in a growing number of African countries, offering an innovative and potentially effective means to create a real-time report system (Vital Wawe Consulting 2009, Rosewell et al. 2013). For the underserved population, SMS-based services appear to be an essential tool for start-ups (Rao 2012). Mobile phones also have a substantial impact on agriculture by improving pricing, reducing wastage and increasing efficiency (Deloitte LLP 2012).

This paper investigates the potential for promoting a handy communication system for communities affected by HWC, with the capacity to quickly inform decision-makers, while also improving the quality of collected data for a better understanding of HWC dynamics. Tailored to the basic mobile phones people are currently using in rural areas, we analyse the potential of FrontlineSMS as a cornerstone of an HWC early warning network through an analysis of the findings of a series of preliminary tests conducted in Mozambique and Zimbabwe between 2011 and 2013.

2. MATERIAL & METHODS

2.1 Study Areas

Training sessions on HWC data management were organized under the auspices of FAO¹. These were held in Zimbabwe from June 2011 for the Zimbabwe Parks and Wildlife Management Authority (ZPWMA) in two rural districts (Chiredzi and Hwange), with about 40 participants from ZWPMA, Agritex² and District administration, and in Mozambique between March 2011 and April 2012 in three selected provinces (Cabo-Delgado, Limpopo and Tete), with more than 60 participants from the Wildlife Department of the Directorate of Lands and Forests (DNTF) and the National Directorate of Conservation Areas (DNAC). Additional training sessions were also conducted in September 2013 through the SISP³ project in Chiredzi, Zimbabwe.

2.2 HWC Data Acquisition

2.2.1 Selection of explanatory variables

¹ TCP/ZIM/3301 and TCP/MOZ/3301 projects.

² Department of Agricultural Technical and Extension Services of the Ministry of Agriculture in Zimbabwe.

³ SISP: Strategic Institutional Support to PARSEL

Key information to correctly analyse any HWC incident was selected in a participatory manner with the workshop stakeholders involved in HWC mitigation. The "5W's and an H" method (Apte et al. 2001) was chosen to guide us in the process of developing data trees of key information needed to understand an HWC problem. Selected variables were then compiled on an A4 form.

2.2.2 Translation of the HWC Incidence in a Set of Qualitative & Quantitative data

To facilitate proper information recording, a series of "wildlife playing cards" were designed; each card corresponded to an explanatory preselected variable. With the help of the cards, an HWC incident was translated on an A4 form (Fig. 1).

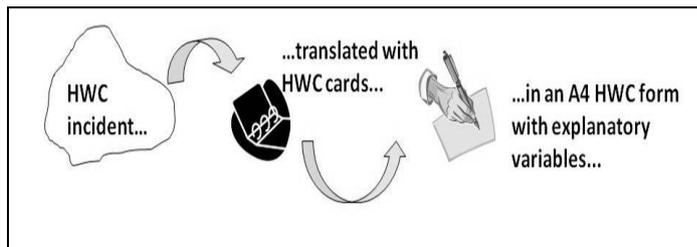


Fig. 1: Recording HWC information with a set of "wildlife playing cards" and an A4 form

The first type of cards was used to record quantitative data (e.g. number of wildlife species involved in HWC). With this card, the recorder was asked to write the corresponding number on the form and to put 0 when no information was available. A second category of cards concerned qualitative information (e.g. category of the species involved in the conflict) with options (e.g. juvenile, female adult, male adult). Instructions were given to the recorder to select an option and write the abbreviation of it on the form. If the information was not available, he was asked to write the question number with a hash symbol (#).

2.3 HWC Data Dissemination and Management

2.3.1 Information Flow

For the information flow overview, we again used the "5W's and an H" method to question workshop participants on who was recording HWC incidents, who needed the information, what the information was used for, and how and to whom the information was to be transferred. The results were summarized on a comprehensive chart that was fine tuned by the participants.

2.3.2 FrontlineSMS

For the transfer and management of the information recorded on the form, we selected FrontlineSMS <http://www.frontlinesms.com>, a free open source software package used by a variety of organizations to distribute and collect information via text messages (Banks 2007a, b). The software does not require an internet connection and can work with only a GSM (Global System for Mobile Communications) or a GPRS (General Packet Radio Service) modem and a computer (Gow and Waidyanatha 2010). It can send and receive text messages (SMS), manage group contacts, respond to messages and trigger other events. At each demonstration site, series of keywords were created to log into the new local system for training purposes and to record HWC incidents. Three types of automatic functions were developed: (i) an auto reply message to message senders, (ii) message transfer to decision-makers and (iii) updating a database under Access (Fig. 2).

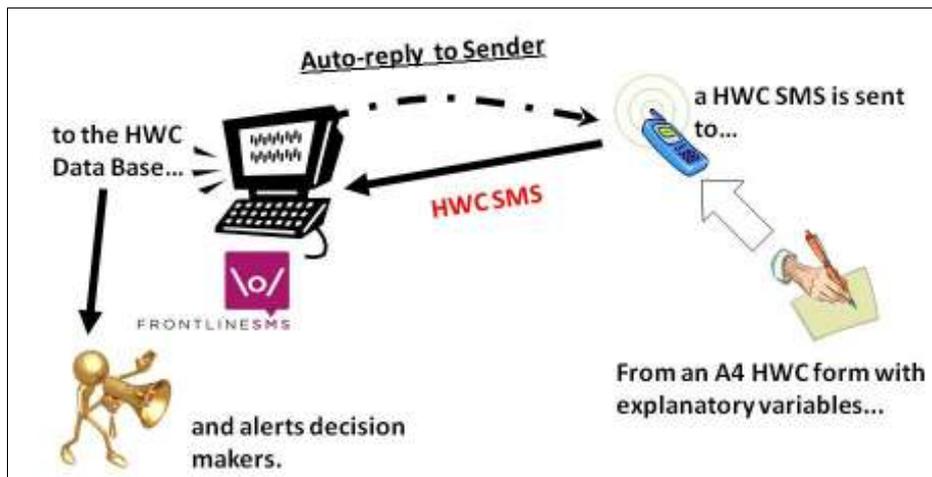


Fig. 2: Managing HWC text messages with FrontlineSMS

2.3.3 HWC Text Messages

Writing the HWC SMS simply involved typing the keyword with a space after it then copying the value of each variable (numbers and abbreviation) captured on the form. The important point was to separate each value with a comma. HWC SMSs were sent to a dedicated number. A successful transfer was confirmed by the reception of an auto-reply message sent by the computer (Fig. 2).

2.4 Monitoring Success

After the training sessions, the system was uploaded by asking game guards to send a weekly SMS patrol report using the same procedure. SMS receptions were monitored to measure how easy the guards got used to sending a wildlife SMS, while also training decision-makers on how to receive such information through this communication channel.

3. RESULTS

3.1 A Complex Flow of Information after an HWC Incident

Following an HWC, in either Mozambique or Zimbabwe, the flow of information is complex because the complainant or the community leader has to provide the information to a range of people who need to be informed or who might play a role in the response the complainant.

In Zimbabwe, this follows the administrative layers of the RDC (Fig. 3), but in Mozambique co-management of the wildlife resource by two different directorates (DNTF and DNAC) adds an additional layer of complexity (Fig. 4).

Interestingly, the results also highlighted that in both countries the information was conveyed at a relatively medium level and often not directly via the complainant or direct informant (Figs. 3 & 4).

Table 1: HWC Data Tree Guidelines

“5W+H”	Question marks about the HWC incident	Information recorded
When	When it happened?	Date Time of day
Where	Where it happened?	Location Coordinates (GPS or reference grid) Designated HWC hotspot or not
Who	Who is concerned?	ID of the complainant and/or affected people. ID of the animal involved (species, age & sex).
What & Why	What was the impact? Why it happened?	Description of the incident: human casualty, crop damage, equipment or infrastructure destruction and livestock predation.
How	How was it mitigated?	Action taken by the complainant or by the wildlife authority to prevent or control the problematic animal.

3.3 Translating any HWC Story with the “Wildlife Playing Cards”

The initially planned approach was slightly modified by taking other existing wildlife forms into account. Ultimately, a set of 52 “wildlife playing cards” was designed and produced in a pocket A6 format.

In practice, when a recorder encounters a wildlife event, he selects a dedicated form (patrol report, wildlife report, anti-poaching report or human-wildlife conflict report) and responds fully to a series questions with the help of the “wildlife playing cards”. For instance, question n°17 on the HWC form used in Mozambique is about the species involved in the conflict. “Wildlife playing card” n°17 offers a list of species mostly involved in HWC, the recorder selects the abbreviation (e.g. ELEF for “elefantes”) and writes it on the form (Fig. 5).

During the training sessions, it took a few minutes to learn how to fill in the HWC form or other wildlife related forms with the “wildlife playing cards”. The only difficulty for the trainees was to understand that an absence of information had to be recorded by placing a hash symbol (#) beside the question number.

1.ESCREVER=		2. ENVIAR=		Exemplo
Cartão-numero=	Escreveo resultado=	SMS=	Separar cada informação com uma virgula =	CABDEL_nome_data
1a Nome do Fiscal=	=	RELATORIO=	Enviar relatório do Administrador do PNQ =	
2a Data do Evento=	=	TELEPHONE=	Comunicar todos os 1 Nome=	
3a Hora do evento=	=			
11a Distrito=	=			
12a Aldeia=	=			
13a Ponto de ref. 36K=	=			
14a Ponto de ref. JTM=	=			
15a Local do evento=	=			
16a Zona de maior frequência=	=			
17a Nome de Espécie enviada=	=			
18a Numero de Espécie enviada=	=			
19a Sexo de Espécie enviada=	=			
19a Idade de Espécie=	=			

Nome	Abreviação
Butor	BUTA
Crocodilo	CROCO
Elefante	ELEF
Facócinha	FACOC
Furca	FURCA
Hipopótamo	HPO
Leão	LEAO
Macaco	MACA
Porco-espina	PESP
Porco-bravo	PBRA
Quilua	QUILUA

1. Nome de Espécie enviada
2. Numero de Espécie enviada
3. Sexo de Espécie enviada

Fig. 5: Using the HWC form with the help of the “wildlife playing cards” in Mozambique

3.4 Sending Wildlife SMS: A Formality

Once the proper keyword was selected, typing the SMS by copying the abbreviation recorded on the form was a formality for most of the trainees. The only difficulty was to check before sending the SMS that a space was separating the keyword from the rest of the text message, with a comma placed between each word (Fig. 6).

- A keyword and a space to instruct the the computer to send an auto-reply and a forward message.

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CHIU_20/3/2011,nig,Chir,22,Dumela,6#,7#,hom,
Blessing,hye,2,fad,0,14#,15#,0,17#18#,19#,20#,
21#,22#,23#,24#,25#,goa,3,fem,adu,hom, fen, monit

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- Each variable separated by a comma

Fig. 6: Set-up of an HWC text message ready to be sent

3.5 Managing Wildlife SMS with Frontline

The issue of connecting the computer to a local network with a GSM modem was solved by testing available commercial 3G USB modems. In Mozambique, the system worked best with a 3G USB modem from Huawei provided by the mCell operator. In Zimbabwe, the same result was achieved with a 3G USB modem from Huawei provided by the TELECEL operator and with a locally manufactured 3G USB modem provided by the ECONET operator.

The creation of groups of informants and decision-makers according to the expected information flow pattern (Fig. 7) was facilitated by the user-friendly design of FrontlineSMS (Fig. 8). The same was done for the creation of keywords with their attributes, including an external command to facilitate the automatic transfer of information to the HWC database developed under Access (Fig. 8).

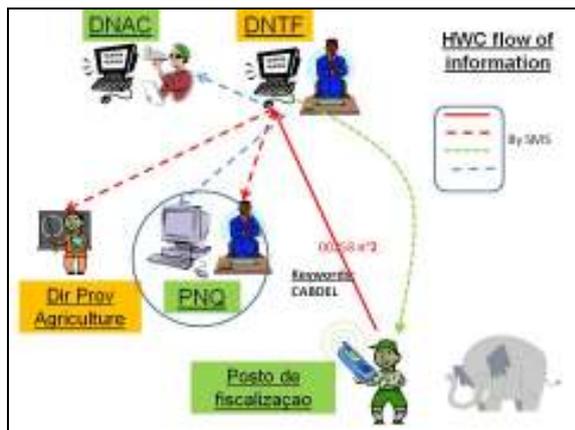


Fig. 7: In Mozambique, the information generated by game guards is sent by SMS to the DNTF national computer using a dedicated phone number (00258N°1). An auto-reply message indicates to the sender that his message has been received by the DNTF computer. The keyword forwards the message to decision-makers at the national level (DNAC) and at the local level to the Park administrator and to the office of the Provincial Director of Agriculture

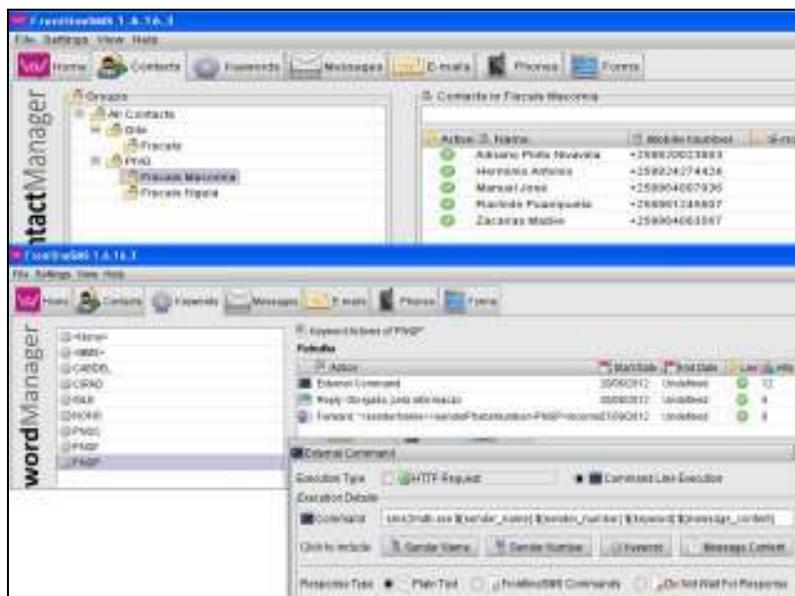


Fig. 8: The three PNQP keyword attributes: sending an auto reply, forwarding the message content to decision-makers and transferring the message content to an HWC database under Access

3.6 Monitoring the Innovation

3.6.1 Registering to Participate in the System

The workshop participants were registered as members of informant groups or decision-maker groups during the workshops by sending a short SMS with the keyword chosen for this exercise followed by a space and their name. The FrontlineSMS system was quickly activated with the creation of local groups of informants, offering applicants a first experience in receiving an auto-reply message from the machine.

3.6.2 Uploading the System with Weekly Wildlife SMSs

Despite the decision taken by the wildlife authority, attempts to send a wildlife SMS on a weekly basis (Fig. 9) failed for different reasons: changes in the team in charge of HWC mitigation, late delivery of 3G USB modems, a lack of support from technicians and wildlife authorities.

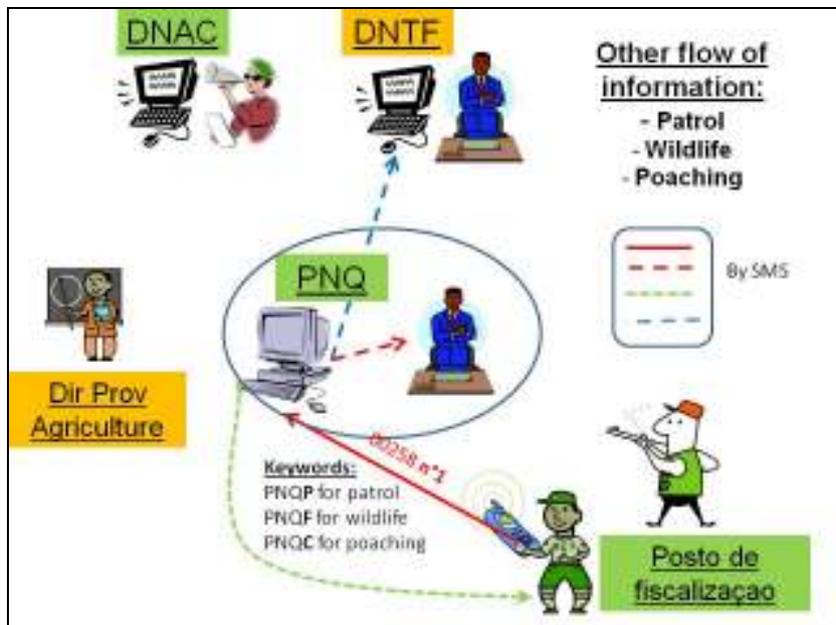


Fig. 9: Testing the FrontlineSMS network in Quirimbas National Park (QNP): information generated by the game guards is routinely sent by SMS to the QNP computer using a dedicated phone number (00258N°1). An auto-reply message indicates to the sender that his message has been received by the QNP computer. According to the different keywords (PNQP for patrol, PNQF for wildlife and PNQC for poaching), the SMS message is automatically forwarded to the administrator of the Park and to the DNTF computer for training purposes. Received SMSs are automatically updating the QNP wildlife database.

4. DISCUSSION

4.1 Considering HWC as a Symptom of a Disturbed Socio-Ecosystem

According to its definition (FAO 2009), HWCs have become more frequent and severe in terms of the disturbance of environments in which human and wildlife populations share the same resources and habitat. With social and environmental risk factors fuelling overall conflicts (Woodroffe et al. 2005), HWCs could be considered as an ecosystem disturbance, requiring strategies developed in response to the threat of emerging zoonotic diseases (Formenty et al. 2011). This coping strategy requests the use of information technology at almost every stage of the process, including data collection, collation, analysis and dissemination. This places a heavy burden on software used for spatiotemporal surveillance (Robertson and Nelson 2010) if the overall objective is to monitor wildlife populations, maintain them at adequate levels, and to restore natural habitats and the balance between predator and prey species.

4.2 FrontlineSMS and other Mobile Data Collection Systems (MDCS)

The UN Foundation has categorized the opportunity of mobile technology in 6 types: education and awareness, remote data collection, remote monitoring, communication and training, disease and epidemic outbreak tracking and diagnosis and treatment support (Vital Wawe Consulting 2009). These systems have a greater ability to influence behaviour than radio and television and have proven particularly effective in targeting hard-to-reach

Fig. 10: The PACL approach whereby HWC is treated as an environmental disease

4.4 Improving the Use of FrontlineSMS

A bottom-up approach to the ownership problem could make this MDCS more user-friendly. Three improvements could be recommended and easily implemented:

- Replacing the GSM modem limited to 6-10 text messages per minute by a GPRS modem supporting a more complete set of AT commands and with a higher data transmission speed of up to 30 text messages per minute.
- Facilitating the typing of text messages with the use of templates pre-stored in the informants' mobile phones.
- Linking the use of this new MDCS with a reward system to improve informants' livelihoods, e.g. a mobile money platform or market information for small farmers.

5. CONCLUDING REMARKS

HWC mitigation - because of its tremendous impact on the conservation of key species and on the livelihood of people in rural communities - requires a better reporting system with the capacity to promptly serve people impacted by HWC and to drastically enhance the overall understanding of this complex human-wildlife interface. In less a decade, mobile phones and SMS exchanges have become part of everyone's life in SSA, boosting the flow of information even in removed areas. Mobile data collection systems such as FrontlineSMS, which were initially developed for human health purposes, appear to be the missing link between hopeless informants and decision-makers. With a few modifications to make it more user-friendly, FrontlineSMS could be a handy tool for NGOs, wildlife authorities and community-based organisations.

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