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RESEARCH ARTICLE

Making adaptive management more user friendly to encourage manager buy-in

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Abstract

1. Adaptive management, whereby monitoring is used to evaluate management interventions with uncertain outcomes, is theoretically well-developed but poorly implemented. Previous work has identified several reasons for this, but there has been little direct investigation into the perceptions of on-the-ground managers (those ultimately responsible for adopting adaptive management).
2. We conducted interviews with nine protected area managers in the Mana–Sapi–Chewore World Heritage Site in Zimbabwe to understand their perspectives on, and extent of adoption of, adaptive management. We focused on how managers use ranger-collected data on elephant poaching to inform their anti-poaching strategies. To better understand drivers of adoption, we also interviewed 18 key informants either working with these managers or familiar with their work.
3. We found that while managers used ranger-collected to guide patrol deployments, data use was basic, short term and reactive. We found little evidence of managers systematically analysing and learning from trends in data to inform anti-poaching. Lack of buy-in and ownership was a significant barrier to adoption of data-based adaptive management. Managers did not see how the approach would help their work, felt that the costs of adoption outweighed the benefits, and were resistant to change from management based on intuition and experience (which they saw as more familiar and dependable).
4. We find strong parallels between drivers of adoption in our study and prominent theories of what affects technology and innovation adoption within organisations more generally. Looking beyond our case study, we contend that the 'human' dimension of adaptive management (manager buy-in and organisational culture) has been under-emphasised compared to technical fixes (like providing more resources and training). Our results highlight the difficulties of implementing adaptive management, rather than critiquing the concept itself.
5. Finally, we generalise our findings to develop a theory of change to promote greater manager buy-in to adaptive management, drawing on principles from

human-centred design to ensure that solutions are sensitive to the priorities and decision-making context of protected area managers.

KEYWORDS
decision-making, elephant, environmental management, evidence-based conservation, management strategy evaluation, poaching, protected area management, technology adoption

1 | INTRODUCTION

Globally, public funds to address diverse and pressing challenges from poverty to climate change are stretched, so finance for biodiversity conservation is often limited and donor dependent. It is therefore imperative that available finances are invested wisely in actions that are well-grounded in evidence. Within conservation management there is an increasing emphasis on 'evidence-based conservation' (Gillson et al., 2019; Sutherland, 2017). There is also a growing appreciation among conservation scientists and practitioners of the need to make decisions that are robust to uncertainty (Bunnefeld et al., 2011; van Wilgen & Biggs, 2011). Adaptive management, whereby ongoing monitoring data are used to evaluate management interventions with uncertain outcomes, is a technically well-developed and widely promoted way of using evidence to inform biodiversity management decisions under uncertainty. Despite this, few examples of its successful implementation exist (d'Armengol et al., 2018; Serrouya et al., 2019).

Since it was introduced over 40 years ago as a process of 'learning by doing' (Holling, 1978; Walters & Hilborn, 1976), adaptive management has come to mean a wide variety of things (Gregory et al., 2006). Its key elements are a management goal, an understanding of the management strategies available to achieve the goal, uncertain ecological and social responses to management actions, ongoing monitoring to measure management outcomes, and learning from experience to enable actions (or goals) to be updated where necessary (Keith et al., 2011). Active adaptive management involves experimentation with management actions (e.g. using controls and treatments; van Wilgen & Biggs, 2011), while passive adaptive management involves a simpler process of implementing management actions, monitoring outcomes and then revising actions based on these outcomes (Keith et al., 2011).

Much literature laments the frequent failure to implement adaptive management. Keith et al. (2011) highlight conflict among stakeholders, institutional complexity and disagreement between scientists and managers as key impediments. Walters (2007) identifies strong individual leaders who buy into monitoring and evidence-based management as key to the few cases of successful implementation within fisheries management (Walters, 2007). Danielsen et al. (2005) conclude that another factor affecting success is the degree to which monitoring is institutionalised within local management structures (e.g. featuring in job descriptions). (Nuno et al., 2014) further identified the importance of institutional barriers and influential individuals in the failure of adaptive management of bushmeat hunting in the Serengeti. Missing from previous work, however, is focussed analysis of how those ultimately responsible for adopting adaptive management (on-the-ground managers) perceive the approach. Yet the pressures and limitations that natural resource managers face, their priorities, worldviews and lived experiences are likely to shape whether they see adoption of adaptive management as worthwhile (Cundill et al., 2012).

Our aim in this study was to understand manager perspectives on the adoption of passive adaptive management in a protected area complex in the Zambezi Valley, Zimbabwe (the Mana–Sapi–Chewore World Heritage Site). We focus on how managers use ranger-collected data on elephant poaching to inform their anti-poaching strategies. Monitoring of poaching dynamics in space and time is essential to evaluating and improving the effectiveness of anti-poaching interventions (Critchlow et al., 2016; Kuiper et al., 2020; Moore et al., 2018), and is therefore, in principle, a key component of managers' roles. We define 'data-based adaptive management' in this context as the systematic analysis and interpretation of trends in ranger-collected data on elephant poaching to evaluate anti-poaching strategies, through a process of learning from data (Figure 1). We interviewed nine protected area managers directly involved in the monitoring and management of elephant poaching at our study site as well as 18 other Key Informants either working with these protected area managers or familiar with their work (mostly staff of the government wildlife authority). Our investigation focusses on the factors affecting the *implementation* of adaptive management, rather than critiquing

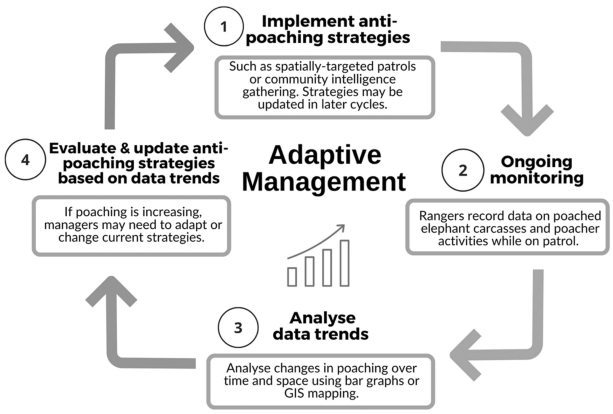

FIGURE 1 A conceptual diagram showing a simplified standard adaptive management cycle and how it would apply in the context of ranger-based monitoring and management of elephant poaching at our study site.

the concept of adaptive management itself. We posed the following research questions:

1. How do protected area managers in the Mana–Sapi–Chewore World Heritage Site currently use ranger-collected data on elephant poaching?
2. How do protected area managers perceive data-based adaptive management and to what extent have they adopted it to manage elephant poaching?
3. What factors affect the extent of adoption of data-based adaptive management by protected area managers?

2 | METHODS

2.1 | Study site and adaptive management through MIKE and SMART

Our study site, the Mana–Sapi–Chewore World Heritage Site (Mana–Chewore hereafter as interviews were not conducted in Sapi) is a complex of protected areas within the Zambezi Valley region of northern Zimbabwe (Figure 2). The site is managed by the Zimbabwe Parks and Wildlife Management Authority (hereafter ZPWMA) and is also one of 69 sites across Africa that form part of a global programme for Monitoring of the Illegal Killing of Elephants (MIKE), established under the Convention on the International Trade in Endangered Species (CITES).[1] The Zambezi Valley elephant population declined from c. 20,000 in 2003 to c. 11,000 in 2014 (ZPWMA, 2015). Large numbers of poached elephant carcasses have been detected by ranger patrols over the last decade (Kuiper et al., 2020). The global MIKE programme provides baseline elephant poaching data to inform both international ivory trade policy and local elephant management (CITES Secretariat, 2019). While the programme is not in itself an adaptive management programme, it does seek to promote the use of ranger-collected data to inform local management decisions at MIKE sites (CITES Secretariat, 2019). For 2014–2018, the Chewore Safari Area was selected as one of eight of high priority MIKE sites across Africa for which a key stated goal was "*Law enforcement, adaptive management and monitoring systems, protocols and capacity are strengthened in high priority protected areas*" (CITES Secretariat, 2018). Furthermore, ZPWMA has partnered with local NGOs (*Panthera* and the *African Wildlife Foundation*) to implement SMART (the Spatial Monitoring and Reporting Tool) across our study site (Kavhu & Mpakairi, 2021). SMART has the potential to be used as part of the adaptive management approach

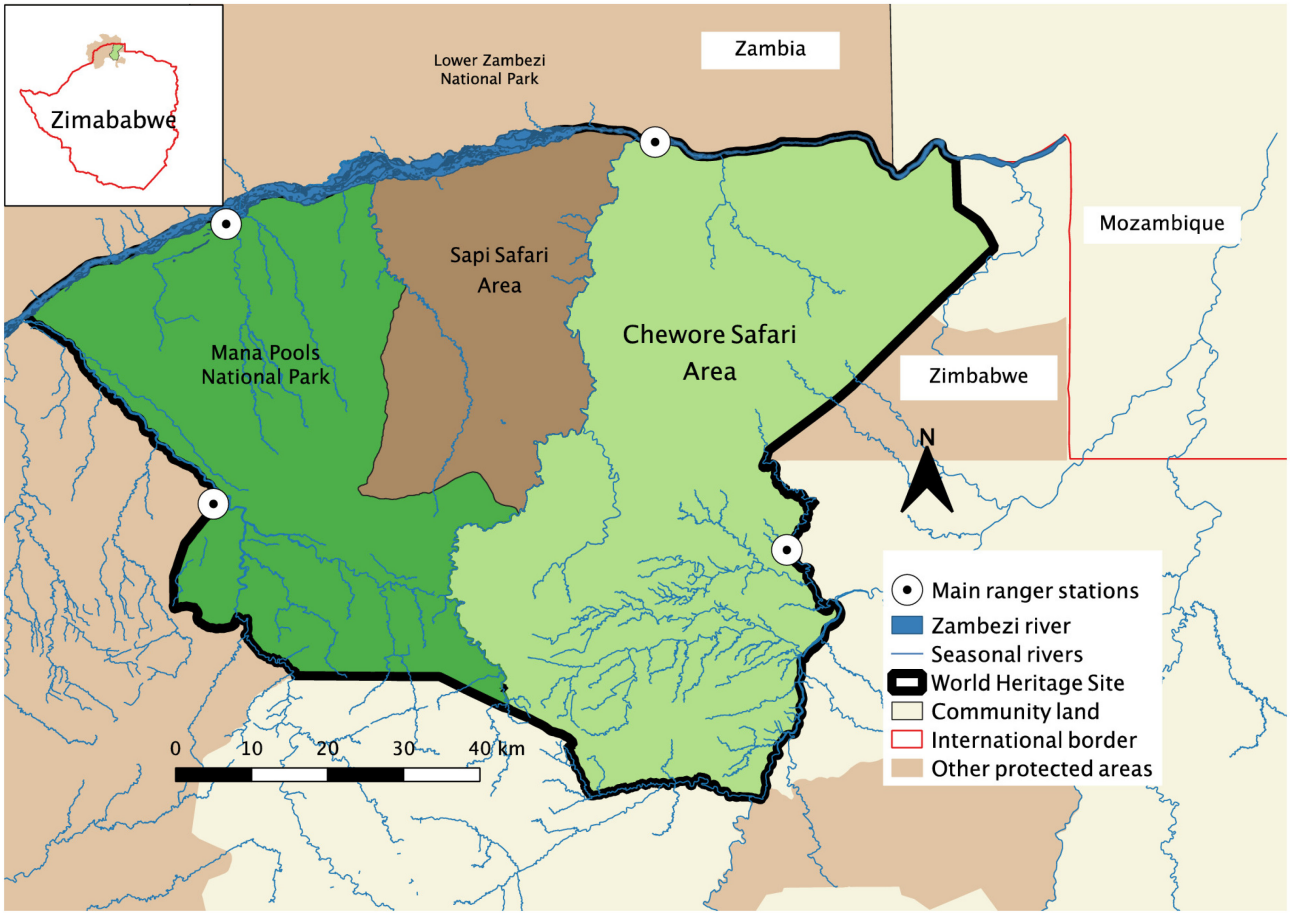

FIGURE 2 The Mana–Sapi–Chewore World Heritage Site in northern Zimbabwe, showing the four ranger stations at which interviews with protected area managers were conducted.

in that it helps conservation managers collect, store and summarise monitoring data on animals and threats.

2.2 | Ranger-based monitoring and management of elephant poaching

Ranger patrols in Mana–Chewore typically involve four to four rangers deployed by vehicle to a temporary camp for six nights, with rangers patrolling outwards from the camp in different directions each day (less commonly, rangers may move camp every two to three nights). Rangers record a wide variety of biodiversity and threat data such as large animal sightings and evidence of poaching, using hard copy notebooks and more recently handheld smart devices (Kuiper et al., 2021). Elephant carcasses are occasionally encountered, and rangers record details such as the cause of death (poached or natural mortality), age and sex of the elephant, and the age (state of decomposition) and location of the carcass, following MIKE guidelines (MIKES Programme, 2015). All patrol observations are reported to protected area managers verbally during patrol debrief sessions at the main station after the 7-day patrol, and then through written patrol reports. Protected area manager responsibilities include the management of resources (vehicles, fuel, patrol equipment, etc.), developing park management and law enforcement strategies, ranger supervision and welfare, and maintaining stakeholder relationships. Anti-poaching strategies at the site include targeted patrol deployment, wider vehicle patrols, reacting to poacher incursions, the establishment of semi-permanent and clandestine anti-poaching bases, and community intelligence gathering.

2.3 | Respondents and interviews

The first author interviewed nine protected area managers across four ranger stations/bases within Mana–Chewore between 1 and 24 August 2018 (Figure 2). Managers are employed by ZPWMA, and all available protected area managers were interviewed at each ranger station. Protected area managers included '*Senior/Area manager*' who had ultimate responsibility for site management, and '*Wildlife Officers*' who shared management and ranger supervision responsibilities. Interviews were individual, face-to-face and semistructured. Manager interview questions covered several broad discussion areas: manager responsibilities and anti-poaching strategies; the collection, storage and reporting of elephant poaching data; the use of these data for park management; and manager perspectives on data analysis and adaptive management. The semistructured approach balanced focus/comparability (the same basic set of questions were asked in each interview), and flexibility (discussion was open-ended and new questions were asked as new ideas arose in conversation; Young et al., 2018). Responses were kept confidential and interview transcripts were anonymised. Each respondent gave free, prior and informed consent for their participation (written and verbal). Respondents were informed of the purpose and endorsement of the research by the most senior manager at each ranger station, as well as by the researcher. All procedures were granted ethical approval by the Human Research Ethics Committee at Oxford University (CUREC REF: R58336/RE001).

To contextualise manager perspectives on adaptive management, the first author also interviewed 18 Key Informants who worked with or were familiar with the work of these managers and/or had expert knowledge around the management of elephant poaching in Zimbabwe or the MIKE/SMART programmes. Informants were selected using targeted sampling of individuals with the desired knowledge/experience, supplemented by 'snowball' recommendations by each targeted individual (Ritchie et al., 2013). The sample included nine senior ZPWMA staff working directly with or senior to protected area managers, four leaders of local NGOs, two local academics and three local wildlife consultants. Interview guides for (a) protected area managers, and (b) additional Key Informants are included in Supporting Information (Appendices S1 and S2).

2.4 | Transcription and thematic analysis

In each interview, the first author took notes while simultaneously audio-recording, followed by partial transcription to provide a balance between efficiency and accuracy (Newing, 2010). Halcomb et al. (2006) argue that full verbatim transcription is not always necessary, especially when interviews are more structured and thematic analysis is guided by clear research questions (as in our study). Based on repetition of information and themes in interview responses, we judged that saturation (the point where additional interviews would yield little new information) was reached for both managers and Key Informants (Newing, 2010). Interviews were analysed using thematic analysis to identify patterns of meaning in the interview data in relation to the specific research questions (Braun & Clarke, 2006). The importance of a theme was assessed by its prevalence both across and within interviews, as well as by the extent to which it spoke directly to the overall research questions. Finally, a theme was accorded higher importance if it was important to a respondent as judged by tone of voice and emphasis, how early on in an answer the theme was mentioned, and repetition of the theme in several answers. Analysis began with immersion in the data (reading transcripts and listening to recordings), after which flexible notes and annotations were made which were eventually developed into themes. Themes were refined through three rounds of coding the transcripts to ensure a final set of themes that represented the data well and addressed our research questions (Newing, 2010). NVivo software was used for thematic analysis (QSR International Pty Ltd, 2018).

2.5 | Supplementary field observations

The first author lived in ranger accommodation at Mana–Chewore for 23 days, allowing for many informal conversations with managers and extensive personal observations. These included observations

of (a) the general work environment of managers (their office space, the operations room, maps on walls, availability and use of computers), (b) general management practices (patrol briefings and debriefings, staff roll call) and (c) various management documents (patrol brief and debrief forms, elephant carcass record sheets, patrol observation record books, etc). Also, at three of the four stations, the first author spent 1–2 h familiarising himself with the computer databases used to store and manage ranger patrol observations (under the guidance of a ranger/managers at each site).

3 | RESULTS

3.1 | Limited adoption of data-based adaptive management by managers

Patrol observations were the most significant source of information used by protected area managers for anti-poaching: "*Which areas to cover and why will be guided by past observations … observations of animals, poacher spoors, contacts with poachers …*" (Manager 3). A common way that protected area managers used these data was to identify poaching hotspots (Table 1), which was done in a basic and qualitative way: "*Our reports from ranger patrols are straight away pins on the operations map, showing carcasses and poacher activities*" (Manager 9; Figure 3a). At all stations, there was no evidence of carcass locations being plotted using computer mapping software, despite SMART software being in use, which should facilitate such mapping.

Elephant carcass data were typically used for short-term patrol to patrol decisions (Table 1), "*During the debriefing we will capture the information on what they have seen, and the results of that patrol will then guide us to the next patrol*" (Manager 5). This is typical of the more reactive approach commonly taken by managers, "*We have deployed some people up there and they have seen a poaching camp, so based on that information we make a follow up to check if illegal activities are still happening in the area*" (Manager 1). As one Key Informant (15) remarked, "*Currently management in the Zambezi Valley is reactive management, it's not adaptive management in the sense of being data-driven*". The use of data to track longer term temporal trends was far less common (Table 1). One manager was not able to tell the interviewer whether there were seasonal patterns in the carcass data recorded over the last few years.

Managers rarely mentioned systematic analysis of trends in poaching data or learning from trends to evaluate the effectiveness of anti-poaching (Table 1). Across all interviews and focussed discussions with rangers/managers responsible for curating computer databases of elephant mortality at each station, general observations during station visits, and informal discussion with managers, we came across only two examples where elephant mortality data had been summarised or plotted in some way (Figure 3b). We also observed only one instance where a longer-term anti-poaching strategy was influenced by carcass data. In this instance, three respondents (managers 7 and 9, and a senior ZPWMA staff member) described how semipermanent anti-poaching 'fly camps' were set up in 2017 in two areas where significant numbers of poached elephant carcasses, poachers' footprints and poacher camps had been recorded over the previous 18 months. A subsequent decline in carcass detections was attributed to these camps: "*That was the major reason why poaching went down*" (Manager 7).

In summary, interview and observational evidence suggest that protected area managers do value elephant poaching data, but data use tends to be (a) short term (patrol to patrol), (b) reactive (as opposed to adaptive) and (c) nonsystematic (no deliberate plotting, predictive analysis of trends and patterns). While managers were aware of adaptive management as a term, they tended not to be familiar with or engaged with the concepts and actions that the approach

TABLE 1 Interview quotes illustrating different ways that protected area managers use ranger-collected data on elephant poaching at our study site, ranked by their importance to managers (as judged by how commonly each form of data use was mentioned during interviews, and how strongly each was emphasised when mentioned).

Data use	Frequency	Quotes
Identify poaching hotspots	Very Common	"*Carcasses help show where the poachers' hunting grounds are*" (Manager 3); "I go through reports and find which areas are hotspots with many carcasses" (Manager 4)
Inform patrol deployments	Very common	"*It influences our patrol patterns; you see animals are killed here so we deploy in those areas*" (Manager 8); "*we deploy rangers … where most elephants are killed*" (Manager 9)
Report to regional and national levels	Common	"*We send the carcass information on to regional and HQ [offices]*" (Manager 5) "*I send the information to my superiors*" (Manager 4)
Track temporal trends in poaching	Occasional	"*Helps to know is poaching increasing or decreasing and why?*" (Manager 4); "*we have seen poaching going down from 2016 to 2017*" (Manager 7)
Flag need for anti-poaching resources	Occasional	"So that they [national headquarters] know what is happening on the ground and whenever we ask for resources they know where we are coming from" (Manager 7)
Inform broader anti-poaching strategies	Rare	"*Carcass info helped in the placement of fly camps [temporary anti-poaching bases]*" (Manager 5); "*We can make some decisions from those trends [in poaching]*" (Manager 7)
Measure the performance of anti-poaching	Rare	"*If you see every year, you are recording more and more carcasses in an area … then you must know that your management plans are actually lacking somewhere*" (Manager 6); "*It is a benchmark, an indicator of how much we are performing at anti-poaching*" (Manager 8)

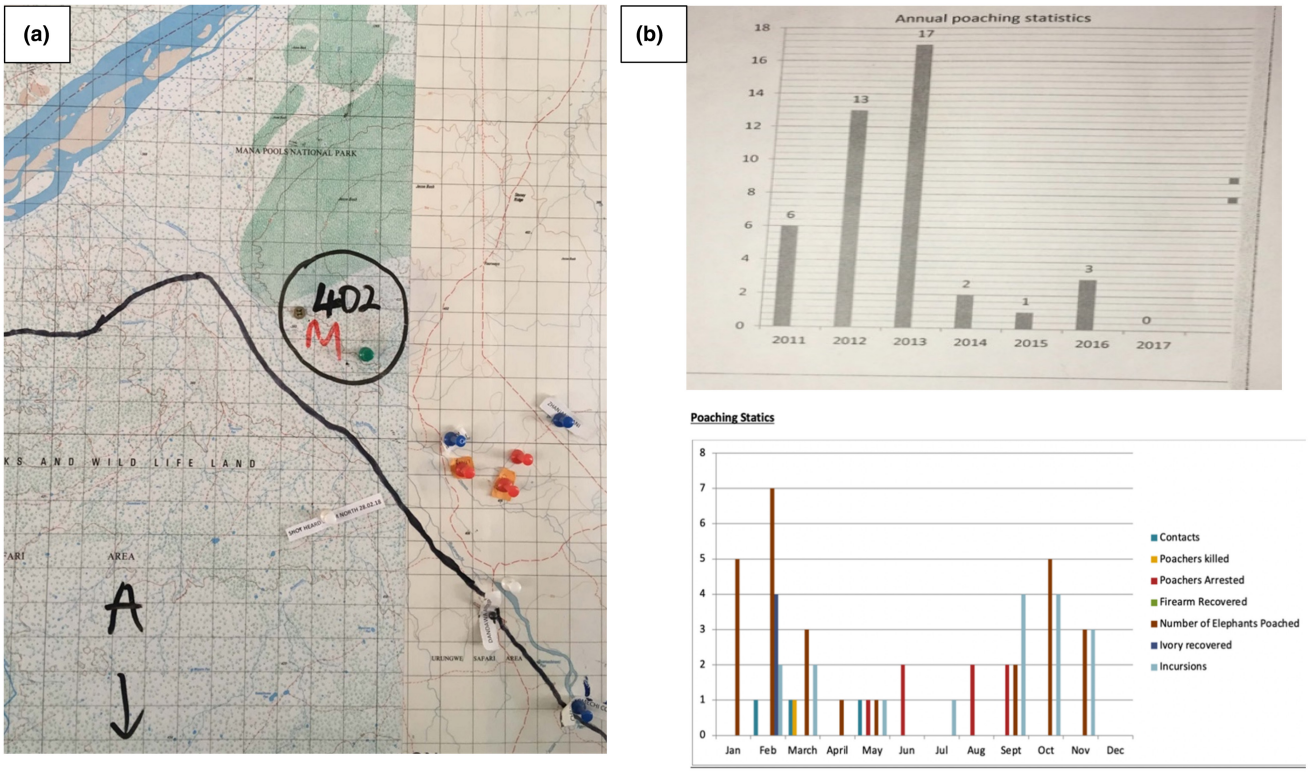

FIGURE 3 (a) An operations map at one of the ranger stations in Mana–Chewore, showing the pins used to indicate the locations of notable observations (including elephant carcasses). (b) Across all interviews and observations of the computer database used at each station, these graphs were the only two examples observed in which protected area managers in Mana–Chewore plotted temporal trends in poaching.

entails. The reasons behind this limited adoption of adaptive management in Mana–Chewore are discussed in the next section.

3.2 | Barriers to the adoption of data-based adaptive management

3.2.1 | Lack of buy-in: Managers do not see how adaptive management will improve their work

Managers generally did not see or understand how data-based adaptive management would help them in their work and felt that the costs of adoption outweighed the perceived benefits (Figure 4; Table 2). One manager, when asked whether graphs of trends in the data would be useful for him, said:

> To date I have not used a graph and I have no problem with that. All the information that they get, that is fed into SMART, comes from me because I am the supervisor of the operations. It is me who initiates that data should be collected … then I look at the data … and then send the data to MIKE … so graph or no graph, I know what is happening in my area.
>
> (Manager 6)

Several Key Informants were sympathetic with manager perspectives and recognised why they felt this way:

> Many managers may not even know why they are doing MIKE and why it is important.
>
> (Key Informant 11)

> A good manager does not need MIKE [data-based management] to know if they are doing a good job. He lives and breathes the park. You have got these guys with experience and intuition.
>
> (Key Informant 10)

When asked about his involvement with MIKE and SMART, another manager said: "*I delegate some rangers to do that [manage SMART/MIKE data] … I am not involved myself*" (Manager 2). Another respondent remarked, "*Technically the system works well, the biggest challenge is implementation and buy in*" (Key Informant 15). Managers were resistant to change from a traditional style of management (based on experience, intuition, practical action and basic data use), which they considered to be familiar and reliable (Table 2; Figure 4). One more senior manager who had been actively involved in the implementation of data-based management systems (SMART and MIKE) highlighted this resistance:

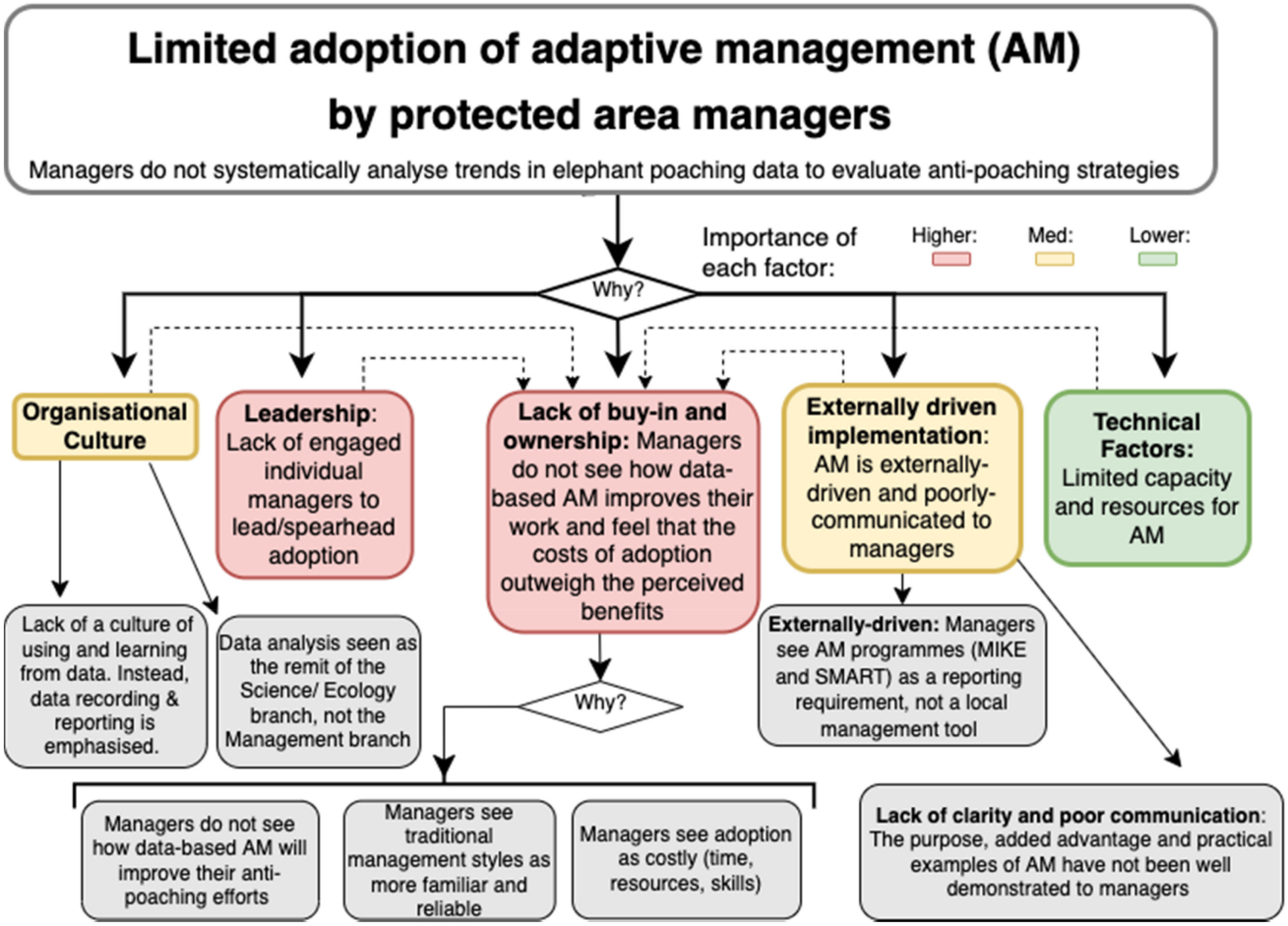

FIGURE 4 Factors explaining the limited adoption of data-based adaptive management by protected area managers in Mana–Chewore, based on analysis of interview themes (the interview and observational evidence to support each aspect of this diagram is provided in the main text). The three colour categories represent the importance that we ascribed to each factor in terms of determining the adoption of adaptive management, based on our overall assessment of interview data and observations. Dotted-line arrows reflect how other factors, while barriers to adoption in their own right, also influence the central factor of a lack of buy-in and ownership. MIKE, Monitoring of the Illegal Killing of Elephants; SMART, Spatial Monitoring and Reporting Tool.

> Most people prefer to use what they are used to, like the map on the wall, unlike this SMART. These sophisticated tools take time. Like when you are using a map in the office you can call in the rangers and show them where there is an incursion. But on a laptop, you will not all be able to see, people will not be able to contribute, we will not be able to react quickly. Like this recent incident with a fire, the guys on the ground radio me the co-ordinates and quickly I can see where they are on the map on the wall. But using a laptop, I cannot react quickly. I am not connected to Google Earth, I need to be trained how to use it, maybe the laptop batteries will go flat …
>
> (Manager 3)

When another manager was asked to describe which system he thought was better, he said "*I have a computer in my brain, I remember the carcases and poachers spoor, I know where the hotspots are, the entry and exit point. Even with new system I will keep going with the manual one. If you give me meat, I won't throw the beans away*" (Manager 4). Protected area managers generally did not appreciate the added value of data-based management, "*until they [manager] actually see how these systems improve what they do, they find it hard to buy into it*" (Key Informant 15). Some managers felt data-based adaptive management was too 'long term' in that it does not address more immediate poaching concerns: "*These MIKE things work when you are on general patrol, but when you are in hot pursuit of poachers … what we need is real time cameras that we can monitor from the office. MIKE is historic*" (Manager 8).

Finally, for many managers the perceived costs of adoption (time and resources to invest in new approaches and skills) were too high, especially considering their diverse and demanding responsibilities. Thus, managers commonly delegated responsibility for managing and reporting MIKE elephant mortality data to others, "*They [manager] have a workload with managing a protected area, so they focus their efforts somewhere else and delegate the MIKE thing to someone else*" (Manager 9). Another manager said: "*I have a dedicated ranger in the office for that, I think they keep the data and also forward it to MIKE … am I correct?*" (Manager 6).

TABLE 2 Interview quotes illustrating the five factors identified as limiting the adoption of data-based adaptive management (AM) of elephant poaching in the Mana–Sapi–Chewore World Heritage.

Factor limiting adoption	Illustrative quotes
Lack of buy-in and ownership: managers do not see how adoption of AM will improve their work	- "*Managers are asking, 'What use will it be to us?'. They should know why they are collecting it [data] and for what reason?*" (Key Informant 11) - "*The acceptability of MIKE is not always there … managers do not appreciate the value of the information … it really requires someone who understands [data-based management]*" (Key Informant 6) - "*I have a computer in my brain, I remember the carcases … I know where the hotspots are*" (Manager 4) - "*The problem is management [protected area managers] should show interest, we have to show buy in and interest, otherwise things here [AM through MIKE and SMART] will die a natural death*" (Manager 3)
Lack of *engaged individual managers* to spearhead adoption	- "*[Leadership] is absolutely crucial. How gung-ho is he [the manager] to get on top of this?*" (Key Informant 8) - "*If a Regional manager has been deeply soaked in MIKE and then said, 'Hey guys, we need this', then that's when we would see value … leadership trumps everything*" (Key Informant 10)
Organisational Culture: Science/Management divide and data reporting emphasised over learning from data	- "*I think the research guys has to do that, they have the responsibility to analyse the data, and then give us advice. If they need the data, we can provide it*." (Manager 9) - "*To a lesser extent are we using that data for management … we are very active in getting the information and reporting it*" (Key Informant 3; senior ZPWMA staff member) - "*I send the data to the main station and the regional office … they ask for the information*" (Manager 7)
Design: AM is externally driven and poorly communicated to manager	- "*Collecting elephant poaching data is now a donor and CITES requirement so we are forced to collect data. CITES is now like a silent supervisor.*" (Manager 3) - "*Many managers may not even know why they are doing MIKE … There needs to be more awareness raised among managers about MIKE. It is a very useful tool.*" (Key Informant 11)
Technical limitations: human capacity and resources	- "*I am very interested in that. I would do it if I knew how to … I would have all the analysis*" (Manager 4) - "*I think the new system is OK if we have the right gadgets … if we have station laptops*" (Manager 6)

Abbreviations: CITES, Convention on the International Trade in Endangered Species; MIKE, Monitoring of the Illegal Killing of Elephants; SMART, Spatial Monitoring and Reporting Tool; ZPWMA, Zimbabwe Parks and Wildlife Management Authority.

3.3 | Lack of engaged individuals to spearhead adoption

Key Informants consistently emphasised the importance of engaged managers to spearhead adoption of adaptive management (see quotes in Table 2). "*MIKE requires a champion at the site who appreciates the value of data. The role of individual managers cannot be overstated*" (Key Informant 4). When asked whether ranger-collected data were being used adaptively, another respondent remarked, "*I think it depends on the type of manager, how proactive and analytic he is. For others [other managers] they just deploy [rangers on patrol] without using information*" (Key Informant 14). Key Informant 2 gave an example of an individual manager who showed initiative in training himself in computer skills and plotting monthly poaching data (this is the manager who produced the plot in Figure 3b). The informant described how data from this manager's jurisdiction were of high quality even though the station in question was one of the more poorly resourced.

3.4 | Organisational culture

3.4.1 | Emphasis on data recording and reporting over data evaluation and use

Many hard copy files, forms and books were observed for recording and storing data of various kinds (patrol observations, patrol briefing and debriefing notes, staff time logs, equipment registries, budgets, etc.). Alongside this, a strong emphasis on regularly reporting these and other data to the regional ZPWMA office for the Zambezi Valley was observed. These included daily weekly, and monthly reports which included information on the status of vehicles, fuel and other resources, the status of staff, notable evidence of illegal activities, notable animal observations, and outcomes of trophy hunts. By contrast, one of the Key Informants with significant operations experience within ZPWMA described how there was very little emphasis on learning from the data that were collected and reported:

> There hasn't been developed within the field management staff that if they are going to manage their areas properly, they need to collect information, analyse it, and evaluate their performance, and then improve it for the next year. How do you, within an organisation, develop a culture of learning and adaptive management? That simply is not happening.
>
> (Key Informant 16)

When asked what happens to elephant mortality data once it is collected, or how these data are used, most managers emphasised reporting these data to higher levels: "*When information is reported from the field, we record it down and report it to the higher offices … daily, weekly, monthly, quarterly and annual reports*." (Manager 1). On several occasions, it was difficult to get managers to talk about how elephant mortality data were used locally because discussions around the use of data would often focus on data reporting.

3.4.2 | Data analysis is seen as the responsibility of the science/ecology section of the organisation

Most managers felt that analysis of data was not their responsibility but rather that of the Scientific Services arm of ZPWMA, or more particularly the 'Ecologist' (the person employed by ZPWMA to carry out research to help management): "*I am not sure. You can get that information from the Ecologist. That's purely research … I am here to see nobody kills elephants and to make sure the rangers deter the poachers*." (Manager 6). One senior ZPWMA staff member remarked: "*Management is responsible for collecting data because it is ranger-based, the Ecologist is responsible for synthesizing the MIKE and other data*" (Key Informant 12). However, a minority of managers recognised that they could work together with the Ecologist on analysis, rather than leave it entirely to them: "*Analysis of data used to be research work, but us on management we could also do that … because we quickly need that information … we work hand in hand with ecologist*" (Manager 3).

3.5 | Externally driven implementation

The CITES requires that MIKE sites like Mana–Chewore report poaching data on an annual basis to contribute to a broader database on levels of illegal killing which is analysed at the continental level to inform international policy (CITES Secretariat, 2022). Despite the international MIKE programme also emphasising the local management value of the datasets that it generates, managers do not see it that way (Figure 4; Table 2):

> Managers are not yet making use of MIKE data locally. They are doing it because they [people responsible for MIKE implementation] are beating their heads to get it out. I would be surprised if area managers put much value on this.
>
> (Key Informant 10)

Managers commonly associated MIKE and SMART (the tool that rangers use to enter data on elephant carcasses in the field) with donations from outside organisations. A manager described the SMART data-based management programme as "*a requirement from CITES and donors, to give more funds*" (Manager 3). These donations were often perceived as the primary benefit of these programmes; "*The landcruiser we got from MIKE was a big benefit*" (Manager 3). A senior ZPWMA staff member saw the programme as an opportunity to get more resources: "*Maybe MIKE could even provide a plane for us to do aerial patrols and cover more area*" (Key Informant 5). This lack of local ownership meant that some managers, rather than analysing MIKE elephant mortality data themselves, expected MIKE as a programme to give feedback on trends in the data: "*MIKE should give us advice on how to manage elephants based on the data we submit to them*" (Manager 9).

Many of the Key Informants ascribed managers' lack of buy-in to poor 'marketing' and communication of the MIKE programme to managers:

> There is room for better communication on what MIKE is to stakeholders … for marketing MIKE to officers on the ground as well as other strategic officers. Are the operations side [manager] aware of MIKE … do they embrace it?
>
> (Key Informant 13)

Poor communication leads to poor ownership (Figure 4): "*If information [on the purpose of the programme] is not shared properly to people on the ground, people might feel it is a requirement for reporting but forgetting that it is actually a tool that can enhance their effectiveness on the ground*" (Key informant 1).

3.6 | Technical limitations: Human capacity and resources

Limited capacity to use technology and interpret data was highlighted as an additional constraint: "*We have people who have field experience, but in terms of academics they are challenged … so it [adaptive management] has to be packaged in a manner that speaks to the capabilities of the people on the ground*." (Key Informant 13). "*There are not many people in ZPWMA who were familiar with computers … he [the manager] can read any small beetle and identify any spoor … but then you say you want digital information … you are asking too much*." (Key Informant 14).

One manager was interested to learn computer-based analysis, but felt unfamiliar with it, "*I tried to ask someone who knows much about computers to assist me, but no-one to assist. I am very interested, I would have all the analysis, but there is no one to teach me*" (Manager 4). Another Key Informant (18) involved in SMART implementation at Mana–Chewore pointed to low manager participation in training exercises (which mostly involved rangers). Managers often did not have the time to commit to the multi-day training workshops or to practice the skills learned.

Regarding resources, managers described how shortages of equipment affect the implementation of SMART, MIKE, and broader adaptive management: "*Yes, we need to work hand in glove with MIKE … I see it is a vital tool … but as long as there is shortage of equipment it will be difficult to implement … cybertrackers … laptops*" (Manager 6). "*We need batteries, GPSes, and computers in order for MIKE to work smoothly*" (Manager 4). Several respondents described how more fundamental management resources were needed for effective adaptive management: "*For MIKE to be effective it leads a lot of resource input … in terms of manpower, vehicles, mobility and coverage*" (Key Informant 13).

4 | DISCUSSION

Previous research has explored why adaptive management often fails in many real-world contexts in ecology and conservation. These studies have analysed single case studies (Serrouya et al., 2019; van Wilgen & Biggs, 2011), reviewed several case studies within a

particular management area (Keith et al., 2011; Walters, 2007) or provided a higher-level appraisal of adaptive management concepts (Gregory et al., 2006; Lee, 1999). Missing from previous work, however, is direct investigation into the perceptions and values of on-the-ground managers themselves, who are ultimately responsible for adopting adaptive management. In this study we found that the perspectives of protected area managers in Zimbabwe towards adaptive management strongly influenced the extent of adoption. Interview data suggest the strongest reason for limited adoption was that managers felt that the cost of adoption outweighed the benefits, especially compared to traditional management practices based on intuition, experience and reaction to shorter term poaching patterns.

When interpreting our results, it is important to distinguish between adaptive management itself, and the implementation of adaptive management (Gillson et al., 2019). As highlighted in our research questions, our focus here is on the implementation and adoption of adaptive management, and as such our results are not a critique of the concept of adaptive management itself. The conceptual advantages of adaptive management are already well established in the literature and in practice (d'Armengol et al., 2018; van Wilgen & Biggs, 2011). Indeed, we highlight in the discussion below several potential advantages of greater implementation of adaptive management at our case study site. However, the potential advantages of adaptive management in our case study and in other systems will not be realised unless it is effectively implemented.

4.1 | Adoption theory: Why managers do not buy-in to data-based adaptive management

Adoption theory, which examines the choice individuals make about whether to adopt a particular technology or innovation, is a useful lens through which to consider the reasons for manager' dubiousness about the value of adopting adaptive management. The innovation of adaptive management in this context involves both an idea (that of making decisions based on learning from data), and tangible technologies (such as computers to analyse and summarise data). Straub (2009) reviewed three dominant theories of innovation adoption (with a focus on school environments), concluding that adoption is a complex social and developmental process, as individuals form "*unique but malleable perceptions of technology that influence their adoption decisions*". He argues that to address poor adoption, the cognitive and emotional perceptions of end users must be carefully considered, as well as their broader work context (Straub, 2009). Protected area managers in Mana–Chewore expressed cognitive concerns about data-based adaptive management. They were not familiar or comfortable with analysing data systematically, nor did they believe adaptive management would improve their anti-poaching efforts.

An influential theory of adoption, which has been developed using empirical comparison of several adoption theories and refinement of their salient characteristics, is the *United Theory of Acceptance and Use of Technology* (UTAUT; Venkatesh et al., 2003). The theory proposes four key determinants of technology adoption: (1) *performance expectancy* (the degree to which an individual believes the innovation will assist them in fulfilling their duties), (2) *effort expectancy* (the perceived ease of using the innovation), (3) *social influence* (whether or not an individual feels pressurised by important others to adopt the innovation) and (4) *facilitating conditions* (the degree to which an individual believes that there is an organisational infrastructure in place to support the innovation).

We found the UTAUT to be particularly useful in helping to explain the limited adoption of adaptive management in Mana–Chewore (Table 3). Low performance expectancy was perhaps the most important driver of poor adoption and low levels of manager buy-in

TABLE 3 A summary of how the four key determinants of innovation adoption developed in the *Universal Theory of Acceptance and Use of Technology* (Venkatesh et al., 2003) help explain why protected area managers in Mana–Chewore have shown only limited adoption of and buy-in to systematic data-based adaptive management. The drivers of adoption closely parallel the drivers of manager buy-in to adaptive management that we identified from interview data (Figure 4). Strategies to address these drivers of adoption are presented in the theory of change in Figure 5 below.

Four drivers of adoption	Relevance to adaptive management in Mana–Chewore
Performance expectancy	Protected area managers see traditional management styles (based on experience, intuition and only basic data use) as familiar and reliable. They generally do not see how data-based adaptive management will improve their anti-poaching efforts, partly because they do not fully appreciate its potential
Effort expectancy	Managers are not comfortable with the specialist skills required for data analysis, which they perceive as unnecessarily complex and time consuming compared to more basic data use (such as a map on the wall with pins indicating poached elephant carcass locations)
Social influence	Managers feel a strong obligation to record and report poaching data, due to external pressure from 'important others'—in this case, both the MIKE programme and their own organisation (ZPWMA), but less pressure to use these data adaptively themselves
Facilitating conditions	The organisational culture at ZPWMA emphasises data collection and reporting over data use. The organisational structure also creates a division between the Scientific and Management arms which makes collaboration difficult. Also, basic facilitating infrastructure such as computers and digital displays is absent from many ranger stations

Abbreviations: MIKE, Monitoring of the Illegal Killing of Elephants; ZPWMA, Zimbabwe Parks and Wildlife Management Authority.

(Figure 4). The performance that managers expect from adaptive management may also be lowered by the unpredictability of elephant poaching, and its sensitivity to external nonmanagement drivers like local economic conditions and global ivory price. This may make anti-poaching efforts less amenable to adaptive management compared to other aspects of park management that are more under managers' control and amenable to planning ahead (e.g. fire and water management). In a study of challenges around the adoption of the SMART ranger-based monitoring technology in a Tanzanian park, Wilfred et al. (2019) similarly found that users were not familiar with the technology (leading to a low performance expectancy) and did not feel they had the capacity to use it well (high effort expectancy).

4.2 | Properly assessing and communicating the costs and benefits of adaptive management

Gregory et al. (2006) contend that adaptive management failure may be less to do with the approach itself, but rather with its uncritical application. Are protected area managers in Mana–Chewore perhaps right to resist adaptive management? While ZPWMA and MIKE ostensibly support adaptive management, the key end users (protected area managers) do not see its value. Adaptive management may not be appropriate when there is poor institutional and stakeholder support, or when the costs and benefits of implementation are not clearly evaluated (Gregory et al., 2006). We observed poor communication to protected area managers about what adaptive management is and what added advantage it offers over traditional management styles. Senior ZPWMA staff described a need for 'awareness campaigns' among managers, but they spoke about adaptive management as an abstract concept, and less about specific ways that managers could use data adaptively. This raises the question of what exactly the advantages of adaptive management in Mana–Chewore might be (Table 4). These potential advantages and examples of adaptive management in our case study can be compared to the more reactive uses of data observed in our results (see particularly Table 1).

4.3 | Promoting greater collaboration between management and scientific staff

A common expectation among managers was that the Scientific Services arm of ZPWMA, and particularly the resident Ecologist, should be responsible for analysing trends in poaching data and providing feedback. The demanding and diverse responsibilities of protected area managers, their common aversion to the technicalities of data analysis, and the specific training scientific staff have in this area, suggest that stronger collaboration between managers and the scientific staff could foster more successful implementation of adaptive management. The various forms of data management and analysis required to unlock the advantages of adaptive management, while difficult for managers in Mana–Chewore to carry out alone, may be much simpler for scientific staff of ZPWMA. Indeed, the monitoring and analysis elements of adaptive management in many other contexts are carried out by scientists, not managers (van Wilgen & Biggs, 2011). Interview data suggest that both management and scientific staff would be open to closer collaboration, yet evidence for such collaboration around analysis of management-relevant trends in poaching data was rare in Mana–Chewore. This may be exacerbated by the organisational structure of ZPWMA, in which the scientific and management arms of the organisation remain separated and have different goals.

This gap between research and management has been commonly identified in the literature, attributed among other things to poor engagement between researchers and managers and poor commitment of researchers to conservation implementation (Addison et al., 2015; Knight et al., 2008). In a similar case study of bushmeat hunting in

TABLE 4 Potential advantages of systematic analysis of poaching trends and adaptive management in Mana–Chewore, compared to traditional management practices around elephant poaching. Advantages are based on interview responses, personal observations and the literature.

Advantage	Details
A long-term data archive	Data-based management promotes consistent recording of data in a single historic database, which ensures long-term data access (whereas intuition and experience is lost when a Manager moves on)
Escaping poor conclusions from biased data	Reacting to raw patrol data without appropriate analysis is susceptible to spatial and temporal bias due to nonrandom patrolling patterns (e.g. poaching hotspots may be misidentified)
Monitoring patrol coverage	Recording and mapping of patrol routes and patrol observations can help identify over- and under-patrolled areas
Strategic law enforcement	Spatio-temporal analysis of ranger patrol tracks and poaching hotspots on a near real-time basis will facilitate strategic law enforcement
Identifying seasonal and longer term patterns in poaching	Plotting monthly counts of detected poached carcass can elucidate seasonal poaching patterns and appropriate responses. Analysing annual trends in poached carcass detections may help Managers understand drivers of change, identify resource needs and critically reflect on current management practices
Explicitly evaluating management actions	Assessing how poaching levels respond to management actions can lead to the development of improved anti-poaching strategies (Figure 1)

the Serengeti, Tanzania, (Nuno et al., 2014) interviewed respondents variously involved in research and management and found that the link between research and monitoring and management decisions was weak. Respondents ascribed this variously to poor communication of research results, research that was not management focussed, and low levels of trust in research which was seen as only an academic exercise. As a result, improving the implementation of practical conservation actions was seen as more important than further research and monitoring (Nuno et al., 2014). Looking ahead in Mana–Chewore, it will be important to better understand the barriers to collaboration between scientific and management staff within ZPWMA (Figure 5). Given the lack of capacity and willingness of managers to conduct complex analyses themselves, there may also be a role for collaborations outside ZPWMA: independent researchers could work with managers to develop the more complex models and methods needed to use ranger-collected data reliably to address key management questions (Kuiper et al., 2020).

4.4 | A human-centred approach to adaptive management design

Interview data suggest that the perspectives, needs, aspirations and preferences of protected area managers have still not been adequately considered in the design and implementation of programmes like MIKE and SMART. The field of human-centred design (HCD) seeks to develop products or services that are tailored to the behaviours, needs and current practices of the individual user (Steen, 2011). Although HCD is mostly applied to innovations within computer and information technology, its principles help explain the limited adoption of data-based management in Mana–Chewore. Our results suggest that data-based management does not fit well with the current behaviours and practices of protected area managers, neither does it address a need that they themselves have articulated (Steen, 2011). The HCD approach complements, and in certain respects improves upon, theories of adoption (like the UTAUT discussed above) by

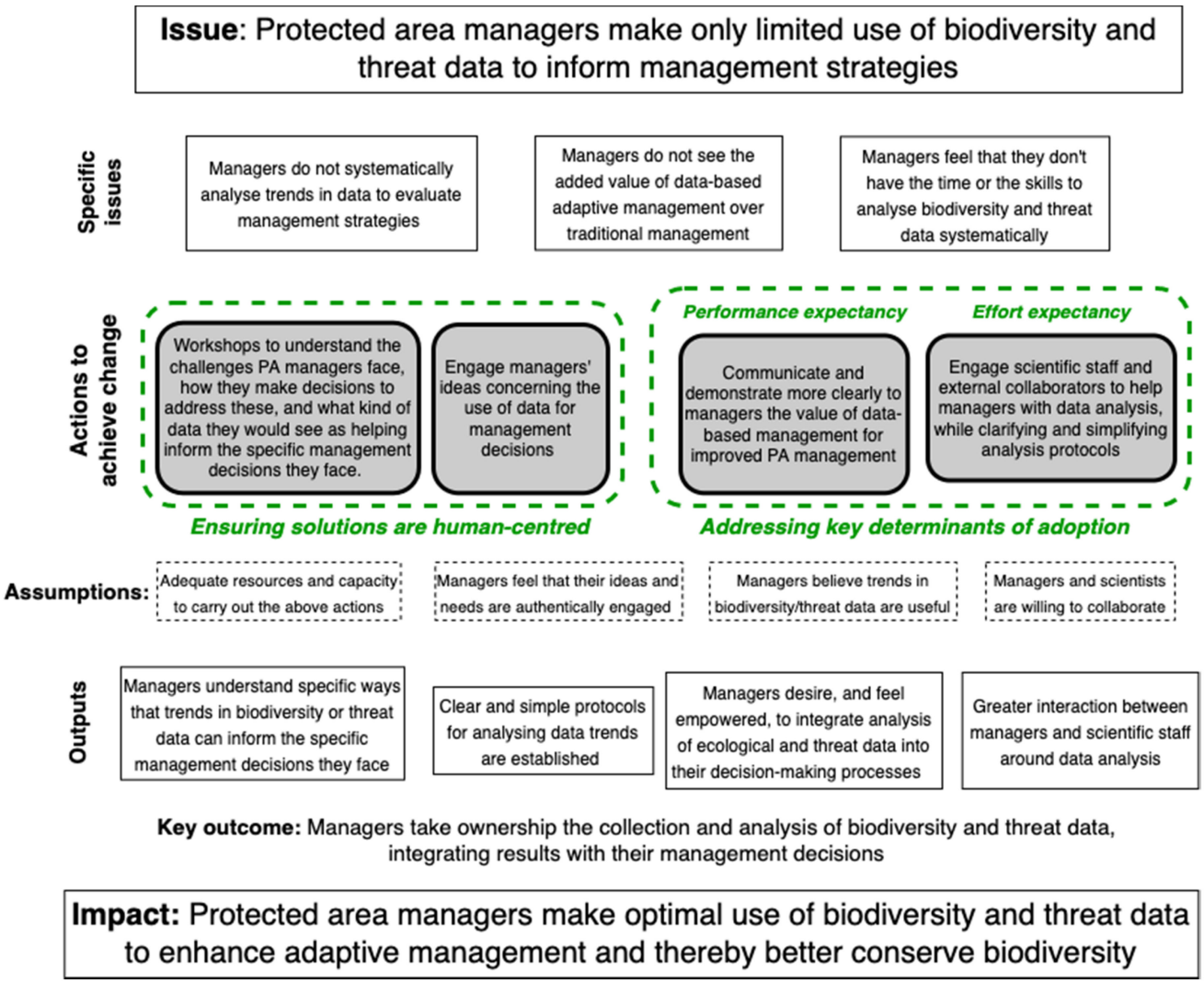

FIGURE 5 A theory of change outlining pathways and actions for achieving the goal of enhanced anti-poaching outcomes through greater use of ranger-collected data by protected area managers in Mana–Chewore. This theory has been developed based on interview findings, as well as key concepts from technology adoption theory (Venkatesh et al., 2003) and human-centred design (Steen, 2011). It seeks to address the drivers of adoption highlighted in Table 3.

focussing on actual people rather than abstract 'users' (the latter can be subtly dehumanising; Jordan, 2002). The approach seeks to ensure that users actually *want* to use the product and are *able* to use it (Steen, 2011). We suggest two ways to make adaptive management more human centred: (1) Connect adaptive management more clearly to the specific management challenges and decision-making context of managers, and (2) Involve managers in adaptive management design (see Figure 5 for suggested tangible actions to achieve this).

Our results suggest that managers simply do not see adaptive management (as currently promoted in Mana–Chewore by MIKE, the NGOs helping to implement SMART, and senior ZPWMA staff) as useful to the management challenges they face and the decisions they need to make. There is an implicit and simplistic assumption that if poaching data and trend graphs are available to managers, then better decisions will naturally arise. Yet research has shown that diverse social, political and psychological factors may influence the decisions of environmental managers, quite apart from trends in monitoring data (Adams & Sandbrook, 2013; McLain & Lee, 1996; Nuno et al., 2014). How do managers in Mana–Chewore currently make anti-poaching decisions? What social, logistical and institutional constraints influence their decisions? Do they feel that data on poaching trends would help them to make better decisions, and how? What sort of information or data would they value? Research or active engagement of managers through workshops to garner manager perspectives on these questions will help the development of solutions that seek to optimise the use of ranger-collected data in the decision-making processes of managers (Figure 5).

Another way to achieve HCD is the active involvement of users in the development of the innovation, so that their experiences and concerns are understood at the outset (Kujala, 2003). Protected area managers, once they begin to see tangible examples of how data-based management might be beneficial (Table 3), will have ideas and practical knowledge about how the approach might best fit within their context. If managers are engaged to provide their own ideas for how ranger-collected data might be used in their decision-making processes and given the opportunity to say what they would find most useful from an adaptive management programme, they might be more prepared to take ownership of data-driven adaptive management (Figure 5). It is important, however, that a range of potential users are involved and that the designer/innovator (in this case the MIKE programme or senior ZPWMA staff) is still given room to articulate the proposed innovation (Steen, 2011). This is because users may vary widely in their practices or preferences and may not always be able to articulate their needs or grasp the purpose of the innovation.

4.5 | A theory-of-change for maximising the ranger-collected for anti-poaching in Mana–Chewore

Fortunately, the beliefs that individuals hold about an innovation are often malleable (Straub, 2009). Greater adoption is possible by carefully addressing the cognitive concerns of users, such as the performance gains that they expect from the innovation, or the ease of its use (Venkatesh et al., 2003). In Figure 5, we propose a theory of change for achieving the goal of protected area managers making optimal use of biodiversity or threat data to inform their management decisions. While our theory of change arises from the findings of our specific case study, we use key concepts from technology adoption theory and HCD to generalise our findings into a broader theory of change that will be useful in other contexts (Figure 5).

Importantly, the overall goal is not greater adoption of adaptive management in Mana–Chewore per se, as we are interested not in the innovation itself but the conservation outcomes it could support. Therefore, the aim is to achieve enhanced anti-poaching efforts through more effective use of ranger-collected data. There are legitimate uses of ranger-collected data that do not require systematic analysis or explicit evaluation of management strategies. Achieving impact (Figure 5) will therefore involve both (a) continuing with current uses of these data which managers find helpful, and (b) identifying opportunities for innovation (including data-driven adaptive management).

Through ongoing knowledge exchange and policy engagement, the ZPWMA have begun work to implement the actions in our theory of change (Figure 5). This has included the tailoring of SMART (the SMART) to help facilitate greater implementation of adaptive management through a tool that is already widely used in the organisation.

5 | CONCLUSION

Our results, interpreted in light of technology adoption theory and HCD, point to more general conclusions about driver of successful implementation of adaptive management in different contexts (with the caveat that our case study was anti-poaching focussed which may differ from other applications of adaptive management). We found strong parallels between our results and prominent theories of the adoption of new innovations/technology within organisations. We contend that the 'human' dimension of adaptive management (managers buy-in and organisational culture) has been under-emphasised compared to technical quick fixes (like providing more resources and training). The theory of change we develop here (rooted in the specific concerns, priorities and decision-making context of managers) may be profitably applied in other contexts where the goal is to optimise the use of monitoring data to improve management outcomes.

AUTHOR CONTRIBUTIONS

Timothy Kuiper conceived and designed the study, prepared the interview guides, conducted the interviews, conducted the thematic analysis and wrote the manuscript. Eleanor Jane Milner-Gulland helped conceive and designed the study, provide oversight and improvement for the thematic analysis and helped write the manuscript. Nobesuthu Ngwenya helped design and review the interview questions, aided with interpretation of interview data and helped write the manuscript. Blessing Kavhu helped design and review the

interview questions, aided with interpretation of interview data and helped write the manuscript. Rosemary Mandisodza-Chikerema helped design and review the interview questions, aided with interpretation of interview data and helped write the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The raw interview data for this study are confidential and cannot be shared as per the original ethical approval conditions for this study

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ENDNOTE

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REFERENCES

Adams, W. M., & Sandbrook, C. (2013). Conservation, evidence and policy. *Oryx*, *47*(3), 329–335. https://doi.org/10.1017/S0030605312001470

Addison, P. F. E., Flander, L. B., & Cook, C. N. (2015). Are we missing the boat? Current uses of long-term biological monitoring data in the evaluation and management of marine protected areas. *Journal of Environmental Management*, *149*, 148–156. https://doi.org/10.1016/j.jenvman.2014.10.023

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology using thematic analysis in psychology. *Qualitative Research in Psychology*, *0887*(January), 77–101. https://doi.org/10.1191/1478088706qp063oa

Bunnefeld, N., Hoshino, E., & Milner-Gulland, E. J. (2011). Management strategy evaluation: A powerful tool for conservation? *Trends in Ecology and Evolution*, *26*(9), 441–447. https://doi.org/10.1016/j.tree.2011.05.003

CITES Secretariat. (2018). *Minimizing the illegal killing of elephants and other endangered species*. https://cites.org/eng/node/17873

CITES Secretariat. (2019). Report to CITES CoP 18 on Monitoring the Illegal Killing of Elephants (MIKE). *CoP18 Doc*, *69*(2), 1–20. https://doi.org/10.22201/fq.18708404e.2004.3.66178

CITES Secretariat. (2022). *Report to the 74th Standing Committee meeting of CITES on the illegal killing of elephants and ivory trade*. CITES. https://cites.org/sites/default/files/eng/com/sc/74/E-SC74-68.pdf

Critchlow, R., Plumptre, A. J., Alidria, B., Nsubuga, M., Driciru, M., Rwetsiba, A., Wanyama, F., & Beale, C. M. (2016). Improving law-enforcement effectiveness and efficiency in protected areas using ranger-collected monitoring data. *Conservation Letters*, *10*(October), 572–580. https://doi.org/10.1111/conl.12288

Cundill, G., Cumming, G. S., Biggs, D., & Fabricius, C. (2012). Soft systems thinking and social learning for adaptive management. *Conservation Biology: The Journal of the Society for Conservation Biology*, *26*(1), 13–20. https://doi.org/10.1111/j.1523-1739.2011.01755.x

Danielsen, F., Burgess, N. D., & Balmford, A. (2005). Monitoring matters: Examining the potential of locally-based approaches. In *Biodiversity and conservation* (Vol. *14*, Issue 11). https://doi.org/10.1007/s10531-005-8375-0

d'Armengol, L., Prieto Castillo, M., Ruiz-Mallén, I., & Corbera, E. (2018). A systematic review of co-managed small-scale fisheries: Social diversity and adaptive management improve outcomes. *Global Environmental Change*, *52*(January), 212–225. https://doi.org/10.1016/j.gloenvcha.2018.07.009

Gillson, L., Biggs, H., Smit, I. P. J., Virah-Sawmy, M., & Rogers, K. (2019). Finding common ground between adaptive management and evidence-based approaches to biodiversity conservation. *Trends in Ecology and Evolution*, *34*(1), 31–44. https://doi.org/10.1016/j.tree.2018.10.003

Gregory, R., Ohlson, D., & Arvai, J. (2006). Deconstructing adaptive management: Criteria for applications to environmental management. *Ecological Applications*, *16*(6), 2411–2425. https://doi.org/10.1890/1051-0761(2006)016[2411:DAMCFA]2.0.CO;2

Halcomb, E. J., Hons, B. N., Cert, I. C., & Davidson, P. M. (2006). Is verbatim transcription of interview data always necessary? *Applied Nursing Research*, *19*, 38–42. https://doi.org/10.1016/j.apnr.2005.06.001

Holling, C. S. (1978). *Adaptive environmental assessment and management*. John Wiley & Sons.

Jordan, P. W. (2002). Human factors for pleasure seekers. In J. Frascara (Ed.), *Design and the social sciences* (pp. 26–40). CRC Press.

Kavhu, B., & Mpakairi, K. S. (2021). Spatial Monitoring and Reporting Tool (SMART) in Mid-Zambezi Valley, Zimbabwe: Implementation challenges and practices. *Conservation Science and Practice*, *3*(9), 1–5. https://doi.org/10.1111/csp2.492

Keith, D. A., Martin, T. G., McDonald-Madden, E., & Walters, C. (2011). Uncertainty and adaptive management for biodiversity conservation. *Biological Conservation*, *144*(4), 1175–1178. https://doi.org/10.1016/j.biocon.2010.11.022

Knight, A. T., Cowling, R. M., Rouget, M., Balmford, A., Lombard, A. T., & Campbell, B. M. (2008). Knowing but not doing: Selecting priority conservation areas and the research-implementation gap. *Conservation Biology*, *22*(3), 610–617. https://doi.org/10.1111/j.1523-1739.2008.00914.x

Kuiper, T., Kavhu, B., Ngwenya, N. A., Mandisodza-Chikerema, R., & Milner-Gulland, E. J. (2020). Rangers and modellers collaborate to build and evaluate spatial models of African elephant poaching. *Biological Conservation*, *243*(February), 108486. https://doi.org/10.1016/j.biocon.2020.108486

Kuiper, T., Massé, F., Ngwenya, N. A., Kavhu, B., Mandisodza-Chikerema, R. L., & Milner-Gulland, E. J. (2021). Ranger perceptions of, and engagement with, monitoring of elephant poaching. *People and Nature*. https://doi.org/10.1002/pan3.10154

Kujala, S. (2003). User involvement: A review of the benefits and challenges. *Behaviour and Information Technology*, *22*(1), 1–16. https://doi.org/10.1080/01449290301782

Lee, K. N. (1999). Appraising adaptive management. *Conservation Ecology*, *3*(2), 3–8.

McLain, R. J., & Lee, R. G. (1996). Adaptive management: Promises and pitfalls. *Environmental Management*, *20*(4), 437–448. https://doi.org/10.1007/BF01474647

MIKES Programme. (2015). *Monitoring the Illegal Killing of Elephants (MIKES Programme): MIKES site monitoring guidelines and procedures*. MIKES Programme.

Moore, J. F., Mulindahabi, F., Masozera, M. K., Nichols, J. D., Hines, J. E., Turikunkiko, E., & Oli, M. K. (2018). Are ranger patrols effective in reducing poaching-related threats within protected areas? *Journal of Applied Ecology*, *55*(1), 99–107. https://doi.org/10.1111/1365-2664.12965

Newing, H. (2010). *Conducting research in conservation: Social science methods and practice*. Routledge.

Nuno, A., Bunnefeld, N., & Milner-Gulland, E. (2014). Managing social–ecological systems under uncertainty: Implementation in the real world. *Ecology and Society*, *19*(2), 52. https://doi.org/10.5751/ES-06490-190252

QSR International Pty Ltd. (2018). *NVivo qualitative data analysis software (No. 12)*. QSR International Pty Ltd.

Ritchie, J., Lewis, J., & Elam, R. G. (2013). Designing and selecting samples. In J. Ritchie, J. Lewis, C. M. Nicholls, & R. Ormston (Eds.), *Qualitative research practice: A guide for social science students and researchers* (pp. 111–142). Sage Publications.

Serrouya, R., Seip, D. R., Hervieux, D., McLellan, B. N., McNay, R. S., Steenweg, R., Heard, D. C., Hebblewhite, M., Gillingham, M., & Boutin, S. (2019). Saving endangered species using adaptive management. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(13), 6181–6186. https://doi.org/10.1073/pnas.1816923116

Steen, M. (2011). Tensions in human-centred design. *CoDesign*, *7*(1), 45–60. https://doi.org/10.1080/15710882.2011.563314

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research*, *79*(2), 625–649. https://doi.org/10.3102/0034654308325896

Sutherland, W. (2017). *What works in conservation*. Open Book Publishers.

van Wilgen, B. W., & Biggs, H. C. (2011). A critical assessment of adaptive ecosystem management in a large savanna protected area in South Africa. *Biological Conservation*, *144*(4), 1179–1187. https://doi.org/10.1016/j.biocon.2010.05.006

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478.

Walters, C. J. (2007). Is adaptive management helping to solve fisheries problems? *Ambio*, *36*(4), 304–307.

Walters, C. J., & Hilborn, R. (1976). Adaptive control of fishing systems. *Journal of the Fisheries Board of Canada*, *33*(1), 145–159.

Wilfred, P., Kayeye, H., Magige, F. J., Kisingo, A., & Nahonyo, C. L. (2019). Challenges facing the introduction of SMART patrols in a game reserve, western Tanzania. *African Journal of Ecology*, *57*(4), 523–530. https://doi.org/10.1111/aje.12634

Young, J. C., Rose, D. C., Mumby, H. S., Benitez-Capistros, F., Derrick, C. J., Finch, T., Garcia, C., Home, C., Marwaha, E., Morgans, C., Parkinson, S., Shah, J., Wilson, K. A., & Mukherjee, N. (2018). A methodological guide to using and reporting on interviews in conservation science research. *Methods in Ecology and Evolution*, *9*(1), 10–19. https://doi.org/10.1111/2041-210X.12828

ZPWMA. (2015). *Zimbabwe National Elephant Management Plan (2015–2020)*. Zimbabwe Parks and Wildlife Management Authority.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Appendix S1. Interview guide used for park managers.

Appendix S2. Interview guide used for Key Informants.

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