Wildlife health perceptions and monitoring in protected areas

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Methods

We developed a web-based questionnaire aimed at protected area managers. The survey had four sections. Under section 1, we asked managers to rank their perceptions regarding wildlife health and potential consequences of pathogen transmission among wildlife, domestic animals and people.

Under section 2, we explored the overall frequency of encounters with dead, sick, or injured wildlife in the protected areas and their documentation when found during patrols.

Under section 3, we asked managers to rank the importance of introduced domestic animals for the conservation goals of the corresponding protected areas. Likert scales were used in sections 1 - 3.

Under section 4, we asked about data storage practices.

Under section 5, we asked about the current state of SMART and its components.

An introductory webpage explained that the survey was voluntary, anonymous, aimed at protected area managers administering SMART data. The webpage also clarified that clicking the "Start the survey" button constituted consent. The survey was built on Google Forms, which has a translation tool. We provided a tutorial on translating it into the preferred language (https://sites.google.com/wcs.org/smarttorecordwildlifehealth/home). The survey was exempt from IRB review (ref #22-53 Wildlife Conservation Society Internal Review Board).

The survey was distributed globally to the SMART Community (SMART Community Forum users https://forum.smartconservationtools.org/) by the SMART Partnership via email in October 2022, and it remained open for three months. As the closing date approached, a reminder was sent to the SMART Community three weeks in advance.

Responses could represent a single or multiple protected areas. However, our analysis focused on responses representing one or two individual terrestrial protected areas to gain insights into specific local realities. Therefore, responses representing more than two protected areas were

filtered out. The resulting dataset could have a specific protected area represented by single responses, by responses that included two protected areas, or a combination of both. We duplicated the responses that were representing two protected areas but left a single protected area for each one, so each row in the dataset implied a unique protected area. One of the responses representing the same protected area after this step were filtered out to leave a unique representation completion and consistency of answers, and respondent's alignment with the intended target audience of the survey.

The protected areas included in the responses were classified as marine or terrestrial based on the World Database on Protected Areas (https://www.protectedplanet.net/en/thematic-areas/wdpa?tab=WDPA). Marine protected areas were removed.

The questionnaire, survey data, data cleaning and filtering, and descriptive analysis scripts can be found at https://github.com/dmontecino/SMART_survey.

Results

General results

The total number of responses was 129.

Seven responses were removed because they included a given name instead of the protected area name and one response was removed because it did not have a protected area name. Twenty-four responses representing more than two protected areas were filtered out and other six were removed because they involved protected areas that were represented once already. Sixteen responses were removed because the respondent did not match the target audience.

The final dataset described below excluded four marine protected areas leading to the removal of another four responses, for a total of 76 protected areas represented by 71 answered surveys (66 responses representing a single protected area and 5 representing two protected areas) from 19 countries.

Section 1: Perceptions regarding wildlife health and potential consequences of pathogen transmission among wildlife, domestic animals and people

The ranking distribution for the following affirmations: "Wildlife health, including infectious and non-infectious diseases, is important to achieve the conservation goals of the protected areas where I work", "Human or livestock pathogens can affect wildlife populations inhabiting the protected area I work", "Pathogens carried by wildlife inhabiting the protected area I work in can affect public health", and "Pathogens carried by wildlife inhabiting the protected area I work in can affect livestock health" is shown in Figure 1.

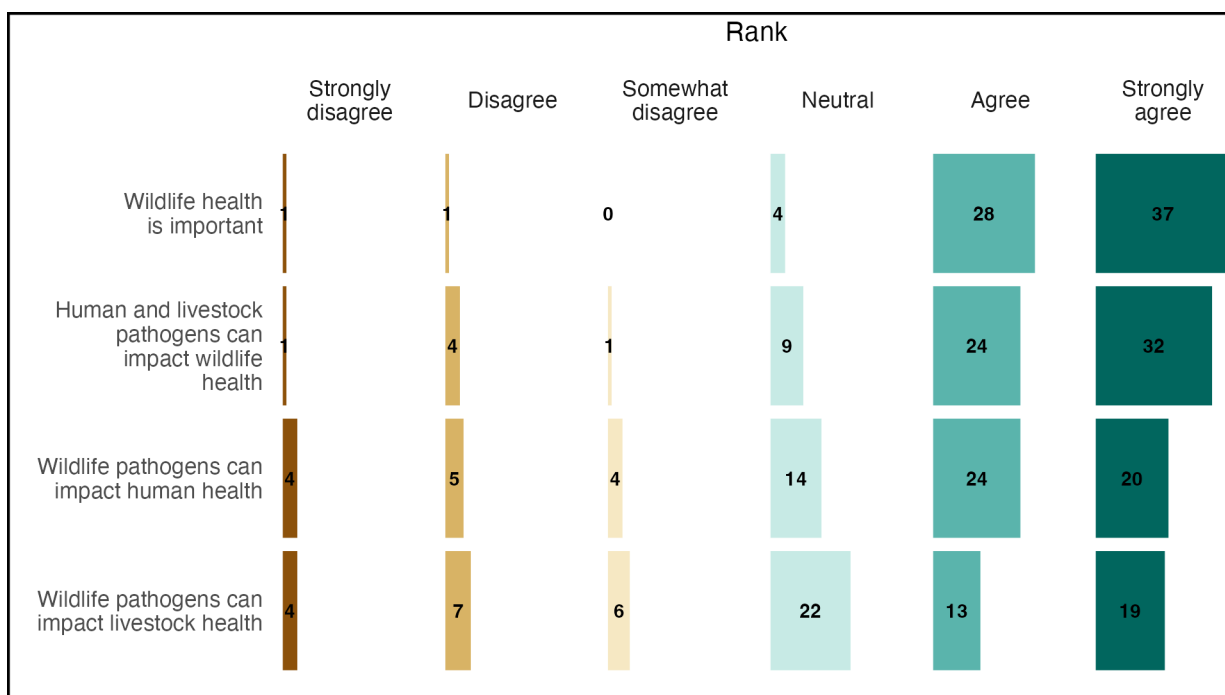|	Rank					
	Strongly disagree	Disagree	Somewhat disagree	Neutral	Agree	Strongly agree
Wildlife health is important	1	1	0	4	28	37
Human and livestock pathogens can impact wildlife health	1	4	1	9	24	32
Wildlife pathogens can impact human health	4	5	4	14	24	20
Wildlife pathogens can impact livestock health	4	7	6	22	13	19

Figure 1: Distribution protected area managers responses regarding the importance of wildlife health to achieve the conservation goals of protected area(s) where they work in (row 1), human or livestock pathogens can affect wildlife populations inhabiting the protected area(s) where they work in (row 2), pathogens carried by wildlife inhabiting the protected area(s) where they work in can affect public health (row 3), and pathogens carried by wildlife inhabiting the protected area(s) where they work in can affect livestock health (row 4).

The most common ranking combination was "Strongly agree" with the four affirmations (n=9; 12.7%), followed by "Agree" with the four affirmations (n=4; 5.6% of the responses). Twenty-eight (39.44%) of the respondents answered either "Strongly agree" or "Agree" to the four affirmations. The number of responses per rank combination are provided in Appendix 1.

Section 2: Overall frequency of encounters with dead, sick, or injured wildlife in the protected areas and their documentation when found during patrols.

Fifty-six responses (78.9%) reported that either dead, sick, or injured wildlife found during patrols are recorded. Twenty out of the 71 respondents (28.2%) answered that dead wildlife found during patrols are not recorded as a specific category. Of this set, only three responses (15%) claimed that dead wildlife are "Never" encountered in the protected area. The overall distribution of responses across ranking of dead wildlife encountering frequency in the protected

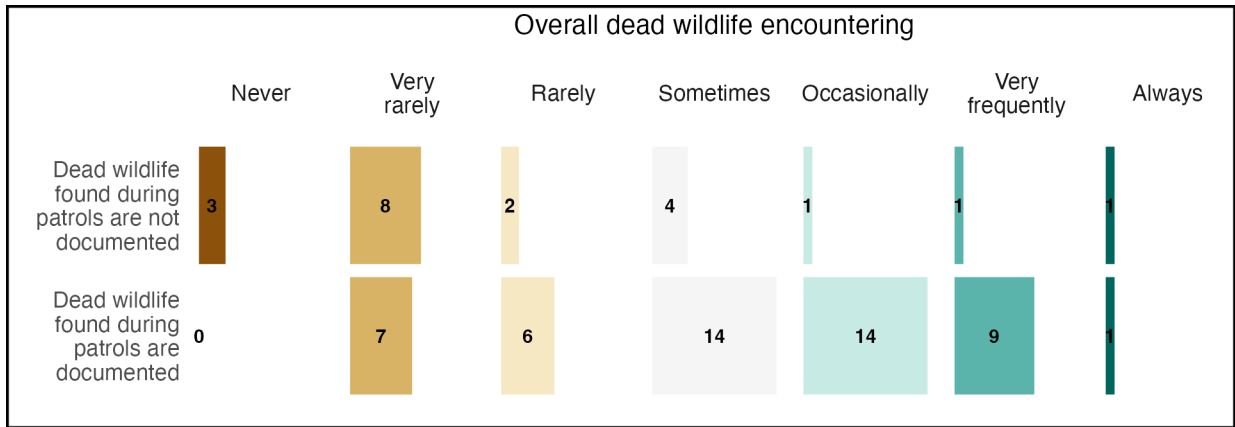area and their recording as a specific category of individuals when found during a patrol is shown in Figure 2.

	Overall dead wildlife encountering						
	Never	Very rarely	Rarely	Sometimes	Occasionally	Very frequently	Always
Dead wildlife found during patrols are not documented	3	8	2	4	1	1	1
Dead wildlife found during patrols are documented	0	7	6	14	14	9	1

Figure 2: Distribution of protected area managers responses regarding the recording of dead wildlife found during ranger patrols as a specific category of animals across the overall encountering frequency with dead wildlife in the protected area(s) where they work in.

Forty-eight out of the 71 respondents (67.6%) answered that sick wildlife found during patrols are not recorded as a specific category. Of this set, only five responses (10.4%) claimed that sick and injured wildlife are "Never" encountered in the protected area. The overall distribution of responses across ranking of sick or injured wildlife encountering frequency in the protected area and the recording of sick wildlife as a specific category of individuals when found during a patrol is shown in Figure 3.
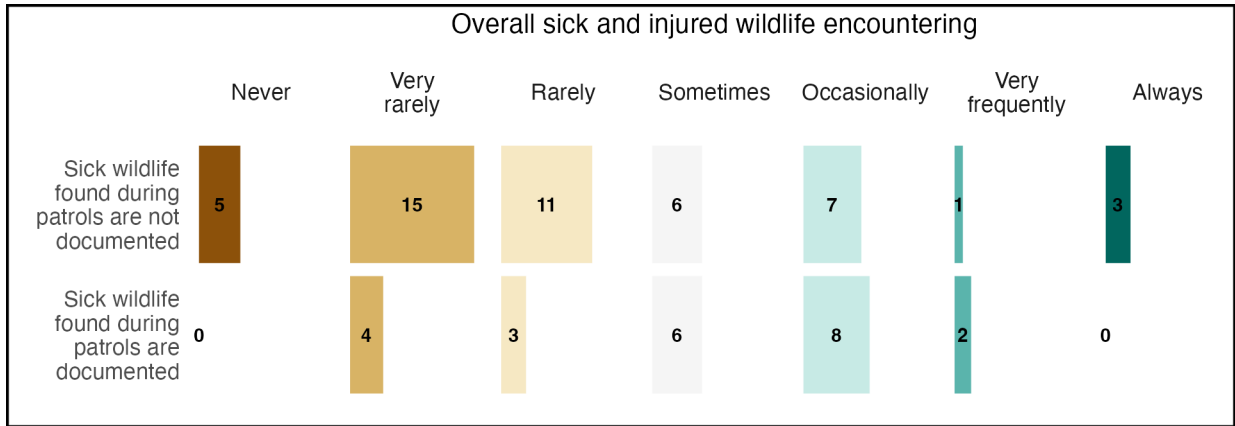
Figure 3: Distribution of protected area managers responses regarding the recording of sick wildlife found during ranger patrols as a specific category of animals across the overall encountering frequency with sick or injured wildlife in the protected area(s) where they work in.

Forty out of the 71 respondents (56.3%) answered that injured wildlife found during patrols are not recorded as a specific category. Of this set, only five responses (12.5%) claimed that sick and injured wildlife are "Never" encountered in the protected area. The overall distribution of responses across ranking of sick or injured wildlife encountering frequency in the protected area and the recording of injured wildlife as a specific category of individuals when found during a patrol is shown in Figure 4.
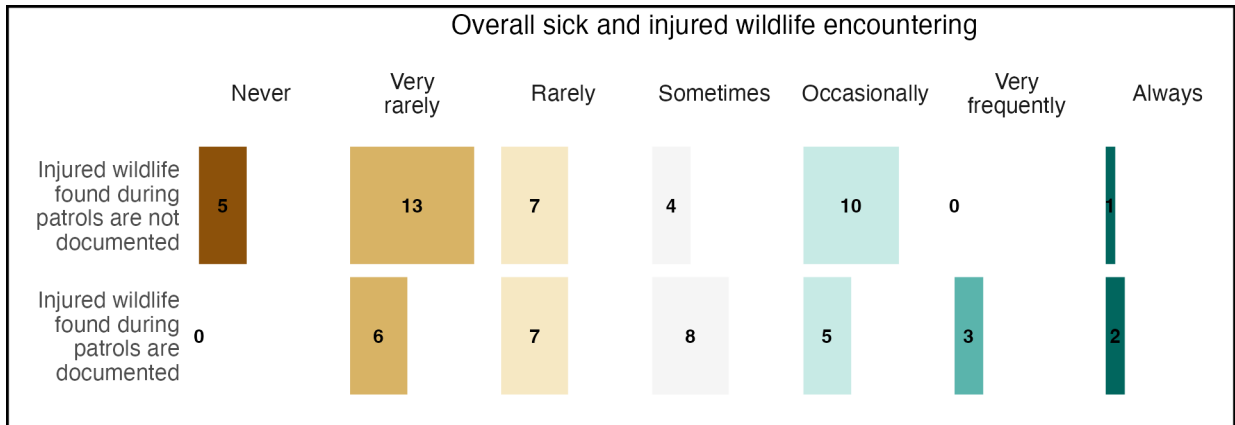

Figure 4: Distribution of protected area managers responses regarding the recording of injured wildlife found during ranger patrols as a specific category of animals across the overall encountering frequency with sick or injured wildlife in the protected area(s) where they work in.

The methods to record either sick, injured, or dead wildlife found during a patrol (when registered) "Part of the full count of the species", "Part of the full count of the species" (stratification of the animals of a specific species per health status), "Present/absent", and "Recorded in another way" were reported in 94.6%, 51.8%, 23.2%, and 17.9% of the 56 responses that reported the recording of either dead, sick, or injured wildlife found during patrols. The distribution of the methods reported to record healthy, sick, injured, or dead wildlife recording when they are found during a patrol is shown in Figure 5.
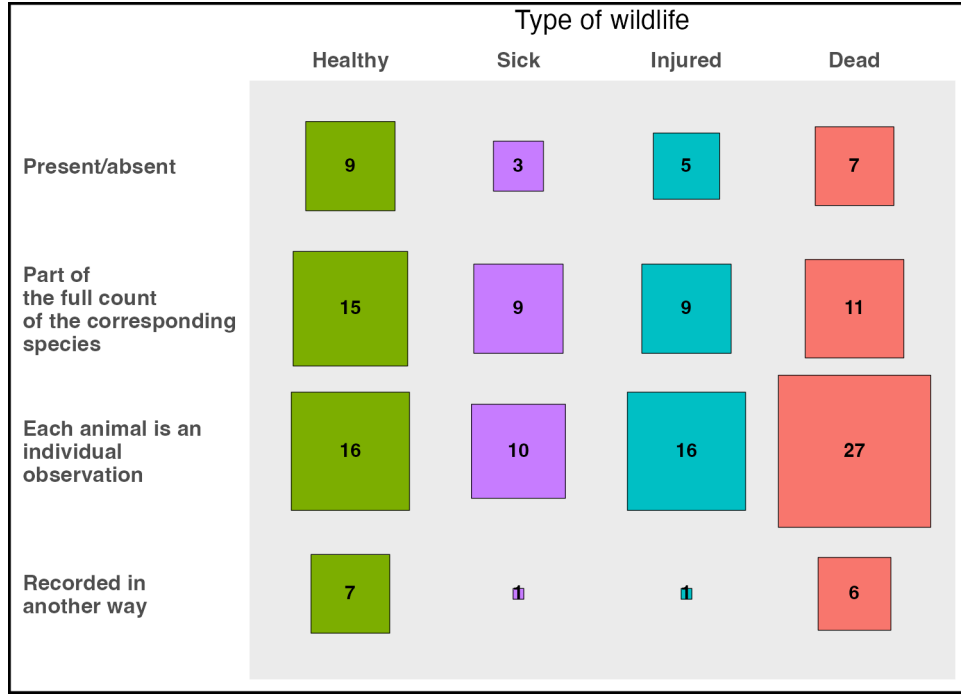

Figure 5: Distribution of protected area managers responses regarding how recorded healthy, sick, injured, and dead wildlife found during patrols are actually registered.

The most common combination of methods to register either sick, injured, or dead wildlife was the recording of dead wildlife only with each dead individual registered as a unique observation (19.6% of the responses), followed by "Each animal is an individual observation" for the three health categories (10.7% of the responses). The number of responses per method used per health category are provided in Appendix 2.

The number of responses including specific data types collected across sick, injured, or dead wildlife (for the set of 56 responses reporting the recording of at least one of these categories) was 55, 51, 41, 37, 33, 30, 25, 21, 17 for the items Species, Photographs, Suspect cause, , Sex, Condition, Age, Anomalies, Other. The distribution of the data items collected per each health status category is shown in Figure 6.
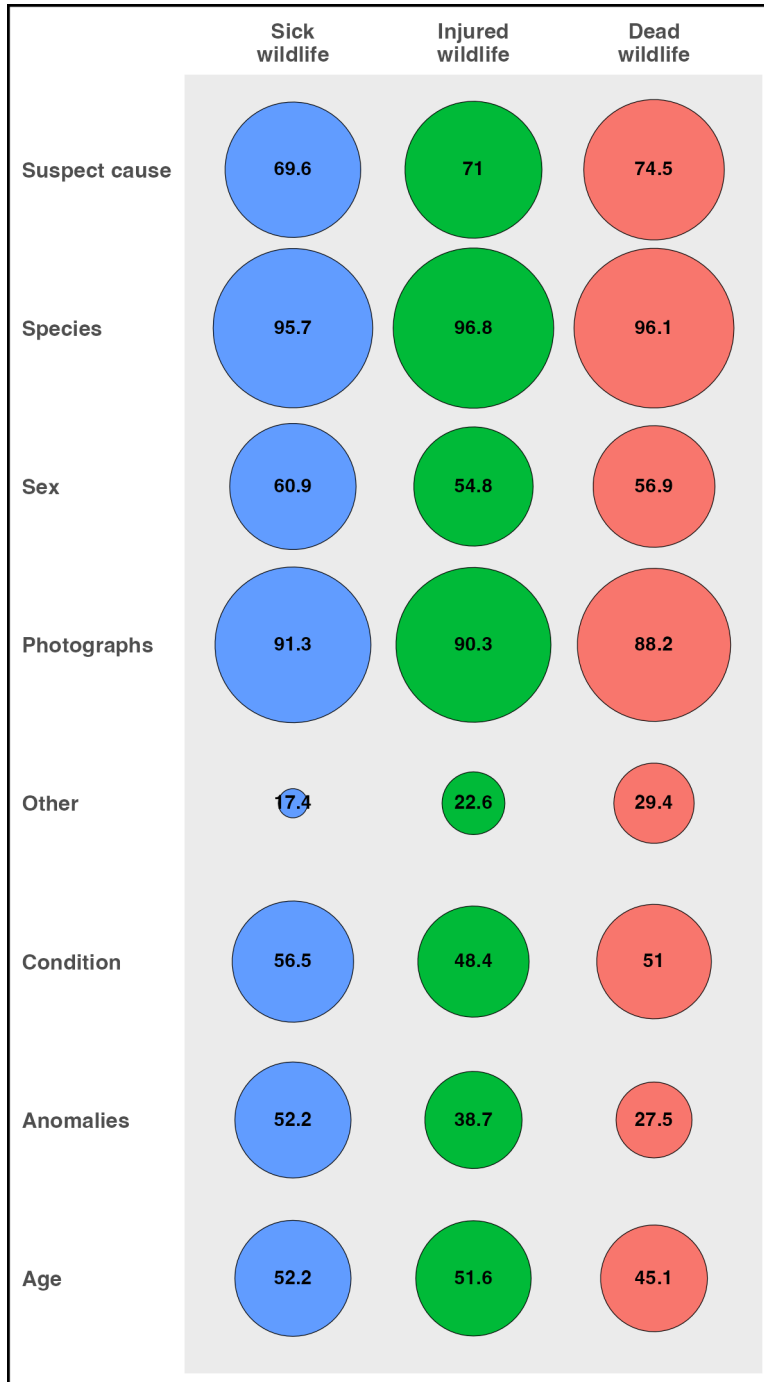
Figure 6: The percentage of protected area managers responses that reported the recording of dead, sick, and injured wildlife that collected different items of information (y-axis) across different categories of wildlife health status (x-axis). The size of the circles is proportional to the percentage observed.

Section 3: Importance of introduced domestic animals for the conservation goals of the protected areas

Fifty managers responded that domestic animals are observed in the corresponding protected areas (70.4%). Thirty-five managers of this subset claimed that domestic animals are documented if observed during patrols (70%), but only 9 of these managers reported the recording of the health status of these animals. The distribution of manager responses across the overall ranking of domestic animals as a conservation concern, their documentation, and recording of their health status is shown in Figure 7.
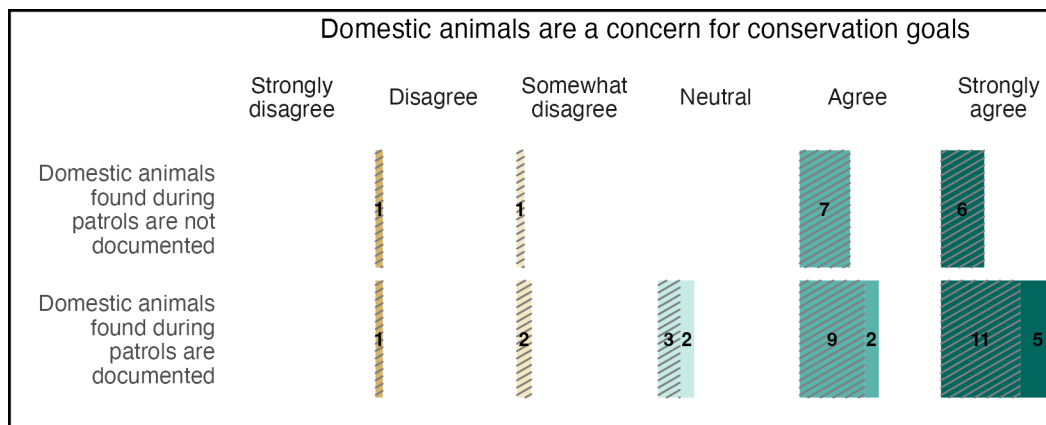

Figure 7: Distribution of protected area manager responses where domestic animals are observed regarding the recording of domestic animals found during ranger patrols across their overall agreement with domestic animals as a concern for conservation goals in protected areas. The dashed area of the polygons represent the subset of responses without health status of domestic animals recording. The responses included in this figure are those of managers that reported the presence of domestic animals in the corresponding protected area.

Section 4: Data storage practices.

Thirty-one of the 35 managers (88.6%) reporting the recording of domestic animal sighted during patrols responded that this information was stored in a SMART database. All managers reporting domestic animals health status recording responded that this information is stored in a SMART database. The distribution of health data storage in a SMART database per wildlife category for those responses reporting the recording of sick, injured, or dead wildlife is shown in Figure 8.

Figure 8: The percentage of protected area managers responses reporting the recording of dead, sick, and injured wildlife (x-axis) that stored this information in a SMART database (y-axis). The size of the circles is proportional to the percentage observed.

In those cases when sick, injured, or dead wildlife were recorded but their data was not stored in SMART, a range of options were employed instead, including paper forms, reports, and spreadsheets.

Current state of SMART components.

Appendices

Appendix 1. Frequency of response combinations to the four affirmations of Section 1.

Appendix 2. Frequency of response combinations to the recording methods for sick, injured, and dead wildlife of Section 2. Cells without information means that the corresponding health categories were not recorded.

Wildlife health is important	Human and livestock pathogens can impact wildlife health	Wildlife pathogens can impact human health	Wildlife pathogens can impact livestock health	Number of responses
Strongly agree	Strongly agree	Strongly agree	Strongly agree	9
Agree	Agree	Agree	Agree	4
Agree	Strongly agree	Neutral	Strongly agree	3
Strongly agree	Agree	Neutral	Neutral	3
Strongly agree	Agree	Strongly agree	Agree	3
Agree	Neutral	Neutral	Neutral	2
Agree	Strongly agree	Neutral	Agree	2
Strongly agree	Agree	Agree	Agree	2
Strongly agree	Agree	Strongly agree	Strongly agree	2
Strongly agree	Neutral	Neutral	Agree	2
Strongly agree	Strongly agree	Agree	Agree	2
Strongly agree	Strongly agree	Somewhat Disagree	Agree	2
Strongly agree	Strongly agree	Strongly disagree	Strongly disagree	2
Agree	Agree	Agree	Strongly agree	1
Agree	Agree	Neutral	Neutral	1
Agree	Agree	Somewhat Disagree	Agree	1
Agree	Agree	Somewhat Disagree	Somewhat Disagree	1
Agree	Agree	Strongly agree	Agree	1
Agree	Agree	Strongly agree	Strongly agree	1
Agree	Disagree	Disagree	Disagree	1
Agree	Disagree	Neutral	Agree	1
Agree	Disagree	Neutral	Neutral	1
Agree	Neutral	Disagree	Neutral	1
Agree	Neutral	Neutral	Agree	1
Agree	Neutral	Neutral	Disagree	1
Agree	Somewhat Disagree	Neutral	Disagree	1
Agree	Strongly agree	Agree	Somewhat Disagree	1
Agree	Strongly agree	Neutral	Neutral	1
Agree	Strongly agree	Somewhat Disagree	Disagree	1
Agree	Strongly agree	Strongly disagree	Strongly disagree	1
Disagree	Agree	Disagree	Strongly disagree	1
Neutral	Agree	Neutral	Neutral	1
Neutral	Neutral	Disagree	Neutral	1
Neutral	Strongly agree	Agree	Agree	1
Neutral	Strongly agree	Disagree	Neutral	1
Strongly agree	Agree	Agree	Strongly agree	1
Strongly agree	Agree	Strongly agree	Neutral	1
Strongly agree	Disagree	Strongly disagree	Strongly agree	1
Strongly agree	Neutral	Somewhat Disagree	Somewhat Disagree	1
Strongly agree	Strongly agree	Agree	Strongly agree	1
Strongly agree	Strongly agree	Disagree	Agree	1
Strongly agree	Strongly agree	Disagree	Disagree	1
Strongly agree	Strongly agree	Neutral	Strongly agree	1
Strongly agree	Strongly agree	Strongly agree	Agree	1
Strongly agree	Strongly agree	Strongly agree	Somewhat Disagree	1
Strongly disagree	Strongly disagree	Neutral	Neutral	1

How sick wildlife is recorded	How injured wildlife is recorded	How dead wildlife is recorded	Number of responses
		Each animal is an individual observation	11
Each animal is an individual observation	Each animal is an individual observation	Each animal is an individual observation	6
		Recorded in another way	5
Part of the full count of the species	Part of the full count of the species	Part of the full count of the species	5
		Present/absent	3
	Each animal is an individual observation	Each animal is an individual observation	3
	Part of the full count of the species	Part of the full count of the species	3
	Present/absent	Present/absent	2
Each animal is an individual observation			2
Part of the full count of the species		Part of the full count of the species	2
Recorded in another way	Each animal is an individual observation	Each animal is an individual observation	2
		Part of the full count of the species	1
	Each animal is an individual observation	Present/absent	1
	Each animal is an individual observation	Recorded in another way	1
	Present/absent		1
	Present/absent	Each animal is an individual observation	1
	Recorded in another way	Each animal is an individual observation	1
Each animal is an individual observation		Each animal is an individual observation	1
Each animal is an individual observation	Each animal is an individual observation		1
Part of the full count of the species	Each animal is an individual observation	Each animal is an individual observation	1
Part of the full count of the species	Part of the full count of the species	Each animal is an individual observation	1
Present/absent	Present/absent	Present/absent	1
Recorded in another way	Each animal is an individual observation		1