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Blending tradition with innovation: how acoustic sensors are revolutionizing rock ptarmigan monitoring

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ABSTRACT

As part of the annual survey of the presence of the alpine ptarmigan in the Granatspitz group in the Hohe Tauern National Park, Carinthia University of Applied Sciences supported the data collection for the first time using acoustic sensors in the spring of 2023. To obtain an initial comparison with the classic point-counting method, acoustic loggers were placed at previously established permanent survey points. Furthermore, the devices were installed at the boundaries of the reference area and beyond to determine how extensively the area is used by rock ptarmigan. The results demonstrated that, despite challenging weather conditions, the required data could be successfully collected using the two tested sensor types.

Tradition trifft Innovation: wie akustische Sensoren das Schneehuhn-Monitoring revolutionieren

ZUSAMMENFASSUNG

Im Rahmen der jährlichen Erhebung zum Vorkommen des Alpenschneehuhns in der Granatspitzgruppe im Nationalpark Hohe Tauern, unterstützte die FH Kärnten bei der Datenerfassung zum ersten Mal mit Hilfe von akustischen Sensoren. Die Ergebnisse zeigten, dass trotz schwierigen Witterungsbedingungen mit den beiden getesteten Sensortypen die erforderlichen Daten erfolgreich erhoben werden konnten. Durch die Kombination von klassischen Monitoringmethoden und neuen Technologien ergibt sich ein immenses Potential für die Datenerfassung.

INTRODUCTION

The rock ptarmigan (Figure 1) (*Lagopus muta helvetica*) belongs to the grouse family and can be found in the Alpine biogeographic region of Austria. Its habitat begins above the tree line in barren areas that are interspersed with rocks and presents a challenging environment [1]. Monitoring the ptarmigan requires enduring difficult conditions due to topography and presence of snow during the lekking season, necessitating thorough preparation. Therefore, staff require specific training in order to undertake ptarmigan monitoring.

Due to its narrow ecological niche and susceptibility to disturbances, specific conservation measures are particularly necessary for the rock ptarmigan [2]. As a species listed in Annex I of the EU Birds Directive, it is essential to establish and maintain protected areas for this breeding bird species. To address these challenges, the use of new technologies, such as acoustic loggers, can make a significant contribution [3]. These tools help minimize the difficulties associated with traditional monitoring methods and enhance the efficiency and safety of data collection in these harsh environments.

Since 2022, the Hohe Tauern National Park has been pursuing the goal of long-term monitoring of ptarmigan along the Granatspitz group. The study examines the long-term effects of disturbance and whether there is a concentration of territories of ptarmigan in certain areas depending on snow cover. To compare the classic bird point-counting method, carried out by park staff, with a state-of-the-art alternative, acoustic sensors were deployed for the first time within the annual survey area, and at the boundaries of the reference area to distinguish the actual area used by ptarmigan.

Fig. 1

Figure 1: Rock ptarmigan at Hohe Tauern National Park. Source: Veronika Grünschachner-Berger

Abbildung 1: *Alpenschneehuhn im Nationalpark Hohe Tauern. Quelle: Veronika Grünschachner-Berger*

METHODS

Field work was conducted in Hohe Tauern National Park up to 2026 meters elevation from May 24th – June 20th 2023. Two different sensor types were used, five AudioMoth 1.2.0 (Open Acoustic Devices, University of Oxford, UK) [4] and four Song Meter Micros (Wildlife Acoustics, Inc., Maynard, MA, USA) [5] were deployed. AudioMoth devices recorded from 4:15 to 8:00 a.m., Song Meter devices were configured to start 1.5 hours before sunrise and end 2.25 hours after sunrise (approx. 4.55 a.m.). For configuration settings, the computer-based apps AudioMoth Flash app, Time App and Configuration App were used to set up the AudioMoth, the smartphone app Song Meter Configurator was used to set up Song Meter Micros. AudioMoth sensors were set to a sample rate of 48,000 Hz with medium gain, while Song Meter devices were also configured with a sample rate of 48,000 Hz but with a gain setting of 18.

For analysis, the machine-learning software Arbimon (Rainforest Connection, Katy, TX, USA) [6] was used to recognize ptarmigan calls within the sound files. Within the software, pattern matching and random forest models (RFM) were utilized.

RESULTS

The AudioMoth devices produced 10,770 files (188 GB) containing 3-minute recordings, whereas 811 Song Meter files (136 GB) were generated at 30 minutes per recording. The analysis revealed 164 detections of ptarmigan calls across all devices and sites. The highest number of ptarmigan calls was found at site 4 (Figure 2). The comparison between the two sensor types showed slightly higher quality and a greater chance of recognition with the Song Meter devices (Supplementary Figure 1a-e).

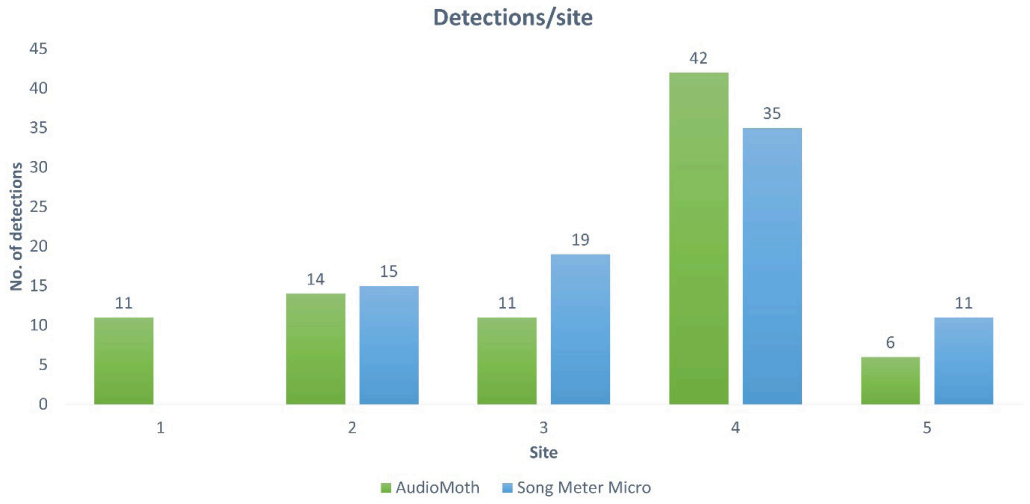


Fig. 2

Figure 2: Number of detection per day and device type, calls were counted once per minute of recording if they occurred (no multiple counts in one-minute recordings). Source: own figure

Abbildung 2: *Anzahl der Rufnachweise pro Standort und Gerätetyp, Rufe wurden einmal pro Minute gezählt, wenn sie auftraten (keine Mehrfachzählungen innerhalb einer ein-minütigen Aufnahme). Quelle: eigene Abbildung*

Most activity was detected in May, at the beginning of the recording period. The number of calls diminished over time as the season progressed. Due to a lack of devices, only AudioMoth was used at site 1 (Figure 3).

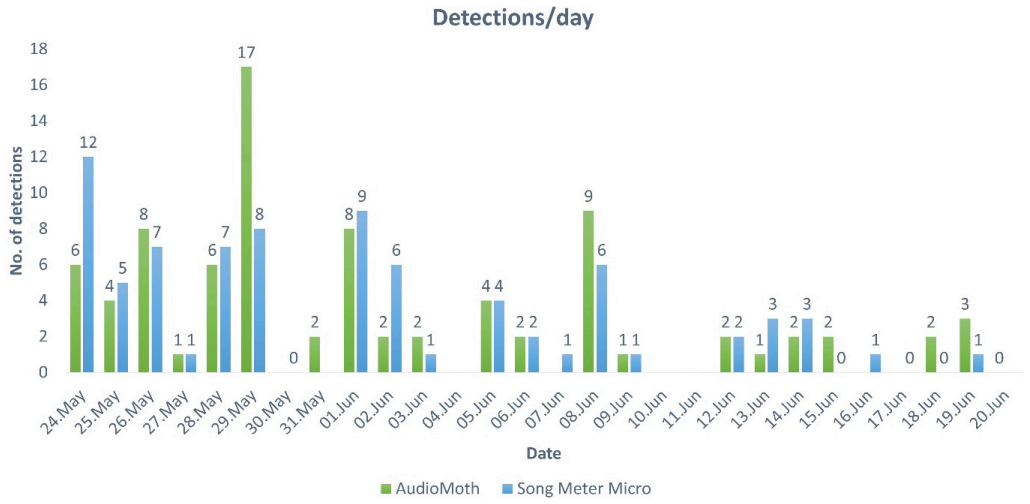


Fig. 3

Figure 3: Number of detections per day and device type, calls were counted once per minute of recording when occurred (no multiple counts in one-minute recording). Source: own figure

Abbildung 3: *Anzahl der Rufnachweise pro Tag und Gerätetyp, Rufe wurden einmal pro Minute gezählt, wenn sie auftraten (keine Mehrfachzählungen innerhalb einer ein-minütigen Aufnahme). Quelle: eigene Abbildung*

As for the recording time during the day, individuals were most active between 4:00 – 4:59 a.m. (Figure 4).

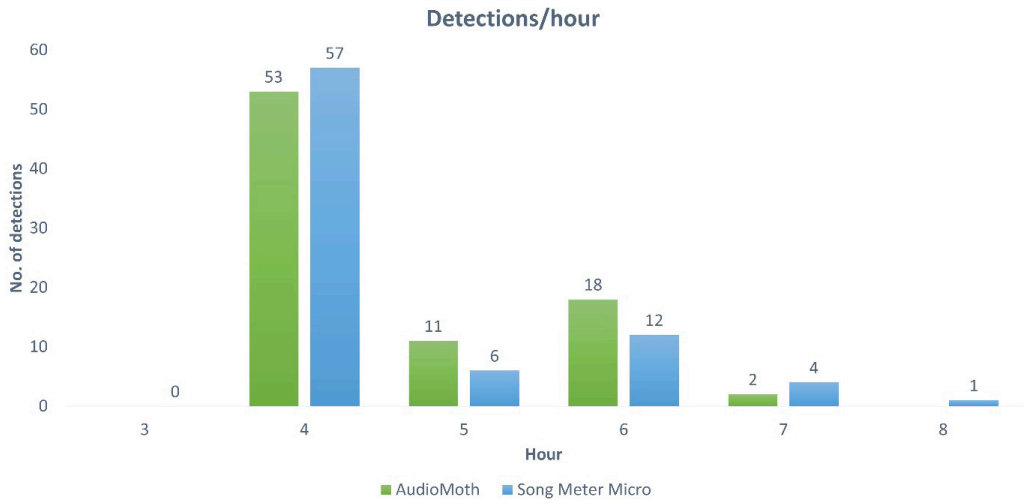
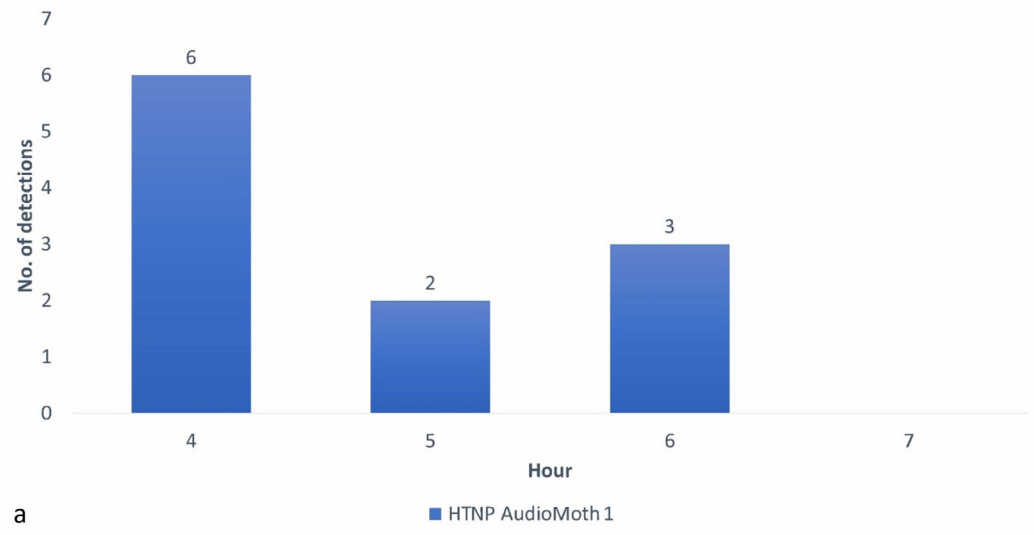


Fig. 4

Figure 4: Number of detections per hour of the day of the day and device type, calls were counted once per minute of recording when occurred (no multiple counts in one-minute recording). Source: own figure

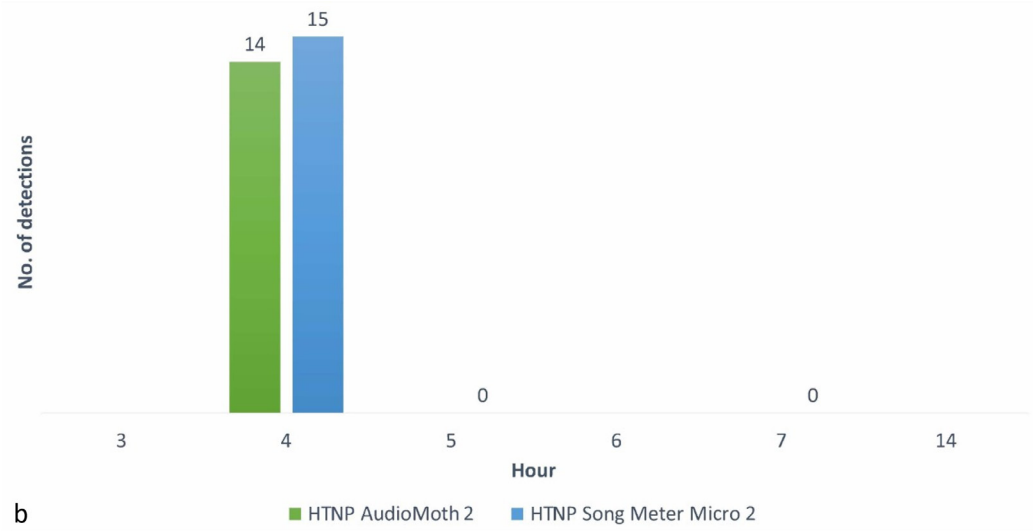
Abbildung 4: *Anzahl der Rufnachweise pro Tagesstunde und Gerätetyp, Rufe wurden 1x pro Minute gezählt, wenn sie auftraten (keine Mehrfachzählungen innerhalb einer ein-minütigen Aufnahme). Quelle: eigene Abbildung*

SUPPLEMENTARY MATERIALS



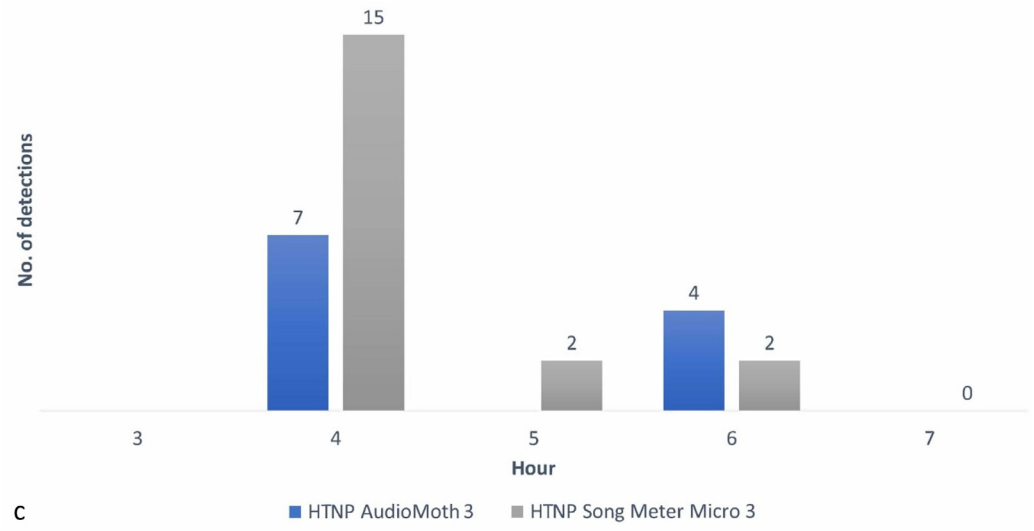
a

Supp. Fig. 1a



b

Supp. Fig. 2b

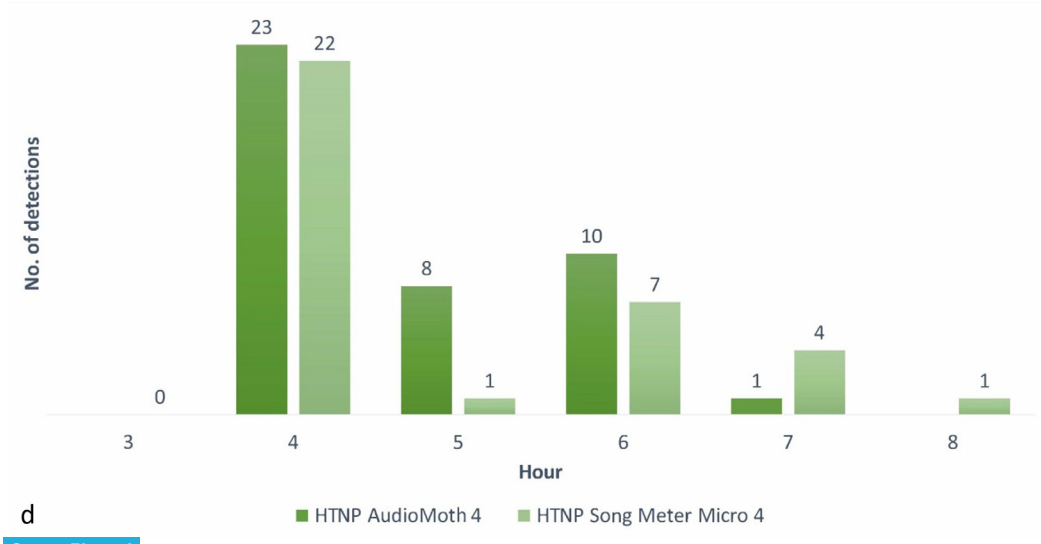


c

Supp. Fig. 3c

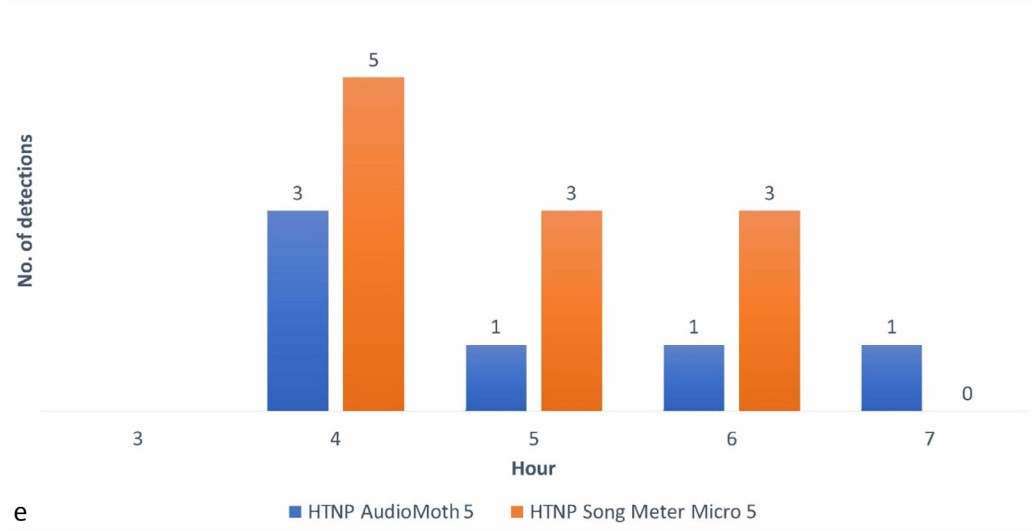
Supplementary Figure 1a: Detections/ hour for each site and device. Calls were counted once per minute of recording when they occurred (no multiple counts in one-minute recording). AudioMoth site 1 (a); AudioMoth and Song Meter Micro site 2 (b); AudioMoth and Song Meter Micro site 3 (c); AudioMoth and Song Meter Micro site 4 (d); AudioMoth and Song Meter Micro site 5 (e)

Ergänzende Abbildung 1: *Rufnachweise pro Gerät und Tageszeit, Rufe wurden 1x pro Minute gezählt, wenn sie auftraten (keine Mehrfachzählungen innerhalb einer 1-minütigen Aufnahme). AudioMoth Fläche 1 (a); AudioMoth und Song Meter Micro Fläche 2 (b); AudioMoth und Song Meter Micro Fläche 3 (c); AudioMoth und Song Meter Micro Fläche 4 (d); AudioMoth und Song Meter Micro Fläche 5 (e)*



d

Supp. Fig. 4d



e

Supp. Fig. 5e

DISCUSSION

As the analysis showed, most detections were found at the beginning of the research period; therefore, the highest activity was already ongoing. This leads to the conclusion that the activity had already started earlier in the year when it is often difficult for researchers to access the sites due to snow conditions, hence an earlier deployment would be an important factor in the years to come to distinguish peak activity. As the highest calling activity occurs early in the morning (see Figure 3), changing the start of the audio recordings to two hours before sunrise, according to the device configuration settings, is recommended to more likely capture the beginning of calling. The analysis revealed that Song Meter sensors achieved greater recognition of bird calls than AudioMoth devices, likely due to the superior ability of Song Meter sensors to distinguish between wind noise and bird calls. Hence, for subsequent research, the Song Meter devices would be a sufficient stand-alone choice. To effectively cover the entire territory, it may be necessary to double the number of sensors, given the uncertainty about the exact size of the area that ptarmigans inhabit. Currently, it remains challenging to accurately deduce the number of individuals, the techniques are not yet reliable enough to provide precise counts. However, as technology continues to advance rapidly, it is likely that technicians will develop methods capable of determining the number of individuals in a recording with much greater accuracy. Thorough preparation and immersion in the respective technologies and analytical programs, as well as verification by experts, are required; however, if these are in place, audio sensors and machine-learning software can be highly beneficial tools for monitoring, especially in difficult conditions.

CONCLUSIONS

The study in Hohe Tauern National Park will continue with a greater number of audio sensors in the following years, justifying the interest to proceed with one audio device type to gather more information and better results in understanding the behavior of the rock ptarmigan, a crucial species. Combining traditional monitoring methods with new technologies offers immense potential for data collection [3].

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