Pine Marten Den Box Monitoring for Conservation

Occupancy and activity assessment using trail cameras and thermal imaging

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Contents

1 Introduction 1
- **1.1** Evidence and experience 1

2 Aim of this guidance 2

3 The purpose of monitoring den boxes 3
- **3.1** Assessing current occupancy 3
- **3.2** Recording den box use over time 3

4 Precautions with monitoring a protected species 4

5 Minimising disturbance to denning pine martens 5

6 Types of den boxes 6

7 Assessing occupancy with thermal imaging 8
- **7.1** How thermal imaging cameras work 8
- **7.2** Minimum recommended specifications 9
- **7.3** Optimising thermal camera settings 9
- **7.4** How environmental conditions affect detection 10
- **7.5** Approaching a den box for thermal checks 10
- **7.6** Thermal detection challenges 11

8 Field signs of den box use 13

9 Choosing a suitable trail camera 14
- **9.1** Important trail camera features 14
- **9.2** Recommended trail camera settings 15
- **9.3** Memory card 15
- **9.4** Batteries 16
- **9.5** Trail camera security 16

10 Setting up a trail camera 17
- **10.1** Field of view 17
- **10.2** Distance 18
- **10.3** Height and aim 19
- **10.4** Camera angle 20

11 Sharing your records 21

12 Troubleshooting 22

13 References 23

Supporting evidence and **acknowledgements**

This guidance has been produced using a combination of evidence obtained from expert opinion and experience, unpublished field research and peer-reviewed literature.

We are grateful to John Martin and Johnny Birks for generously sharing their experience with pine marten den boxes — and also to colleagues at Vincent Wildlife Trust, NatureScot and Forestry England, whose expertise and feedback helped shape this guide.

In many woodlands and forestry plantations in Britain, pine marten den boxes represent a significant habitat enhancement. They provide elevated, insulated resting and breeding sites — a resource that is often scarce or absent due to the age structure and/or management history of the trees (Birks *et al.*, 2005; Croose *et al.*, 2016; Croose *et al.*, 2024). Den boxes can also support pine marten breeding and population establishment (Birks *et al.*, 2026; VWT unpublished data). Consequently, den boxes are typically an important focus of pine marten activity and so provide valuable opportunities for population monitoring. Den box monitoring enables an understanding of factors such as den box occupancy, breeding success and number of kits, identification of individual animals, behaviours at den sites and improving den box design.

The monitoring methods described in this guidance document have been developed following approval by the Statutory Nature Conservation Organisations (SNCO) of Scotland, England and Wales to ensure little to no disturbance to pine martens — and without the requirement to apply for a disturbance licence. Any activity that deviates from this methodology should be discussed with your relevant SNCO to ensure compliance with the Wildlife and Countryside Act (1981).

First published in 2021, this guidance has been updated in 2026 to reflect evidence gained through a combination of data collection, testing and expert experience gained by surveyors. This second edition includes a dedicated section on using thermal imaging to assess den box occupancy, while revisions throughout address common issues identified by practitioners during the five years since the first publication.

1.1 Evidence and experience

The guidance in this document draws on two complementary sources: published research and practical field experience. The role and effectiveness of pine marten den boxes is well established through scientific studies and reports (eg, Birks *et al.*, 2005 and 2026; Croose *et al.*, 2016 and 2024). In contrast, the methods for monitoring den boxes using thermal imaging and trail cameras have developed primarily through field testing and the experience of surveyors.

Den boxes present unique monitoring challenges for this equipment, and approaches have been refined over time through repeated use in real-world conditions. While these methods are not yet widely represented in the published literature, they reflect tested practice developed to improve monitoring reliability and minimise disturbance to denning pine martens. This guidance brings together that experience to provide a consistent and precautionary approach to den box monitoring.



Pine marten inspecting a Galloway Lite den box.

2 Aim of this guidance

This document provides guidance for effectively and responsibly monitoring pine marten den boxes using the technical principles of thermal imaging and trail cameras, suitable for both volunteers and professionals.

The following topics are covered, which provide a workflow from understanding the purpose of monitoring through to successfully capturing footage.

- **The purpose of monitoring den boxes (Section 3)** Monitoring can provide a range of information — from occupancy and breeding success to animal behaviour — depending on the techniques used.
- **Minimising disturbance and legal considerations (Sections 4-5)** Understanding how to monitor a protected species responsibly and lawfully is essential before any fieldwork begins.
- **Recognising common den box designs (Section 6)** Different box designs require different viewing angles and approaches to ensure effective monitoring.
- **Assessing current den box occupancy using thermal checks and past use from field signs (Sections 7-8)** Thermal observations provide the most reliable indication of current occupancy, while field signs may indicate recent use and past activity.
- **Selecting and setting up trail cameras (Sections 9-11)** Trail cameras provide a record of den box use and animal behaviour. Performance varies between models and setups, so this guidance offers practical advice on choosing suitable cameras, identifying optimal monitoring locations, improving camera reliability and troubleshooting common issues.



3 The purpose of monitoring den boxes

Monitoring den boxes provides evidence into when and how pine martens use these artificial resting and breeding dens. Trail cameras and thermal imaging cameras each offer different types of information — and together they build a reliable understanding of den box use.

3.1 Assessing current occupancy

Thermal imaging enables surveyors to determine current occupancy of a den box from a distance. A clear heat signature at the base or front of a box can indicate the potential presence of a pine marten, which will help to guide decisions about whether a close approach can be carried out. Thermal imaging is therefore the primary method for confirming whether a den box is occupied at the time of a site visit.

3.2 Recording den box use over time

Trail cameras can be used to record use of den boxes over time. There are a variety of ways to interpret trail camera footage depending on a project's aims and needs — some common examples are listed below.

Occupancy At a basic level, trail cameras can confirm whether a den box is being used by a pine marten during the monitoring period.

Breeding and kits Footage can reveal breeding success by capturing images of mothers and kits.

Behaviours Trail cameras can also reveal a range of behaviours, such as daily and seasonal patterns of den use, and prospecting a potential den that may be used at a later date.

Identifying individual animals On occasion, very clear footage may capture the distinctively patterned creamy-yellow bib fur of a pine marten, allowing individuals to be distinguished. This should be considered additional data rather than a primary objective, as results are often inconsistent or unreliable.



Pine marten emerging from a VWT-style den box.

4 Precautions with monitoring a protected species

Key principles

1 Assume occupation Take a precautionary approach and behave assuming a den box is occupied.

2 Maintain distance Do not approach within 5m of a den box, unless operating under a pine marten disturbance licence or under the supervision of a licence holder.

3 Minimise disturbance Keep noise, movement and other disturbances to an absolute minimum during all monitoring activities.

Den boxes should be monitored only to support the conservation of pine martens, not for monitoring alone. Close approaches to an occupied den box may alter the behaviour of its occupant(s) and therefore, monitoring decisions should involve carefully weighing the potential impact on the animals against the value of the information gained. Previous observations have shown that female pine martens may remove their kits from a den box shortly after a minor disturbance at the site.

Pine martens have full legal protection in the UK through their listing on Schedule 5 of the Wildlife and Countryside Act (1981). It is an offence to intentionally or recklessly disturb a pine marten when it is occupying a nest or den for shelter or protection. To monitor pine marten den boxes, permission must always be obtained from the landowner as well as the owner of the den box — who may or may not be the landowner. A den box should not be approached or monitored without prior consent. Many den boxes located in public woodlands and forests will likely already be the subject of ongoing monitoring. Once permission from the landowner and den box owner has been obtained, a den box may be monitored without a disturbance licence from a distance of 5m or greater in Scotland, England and Wales, providing that all due care is taken to minimise disturbance (see Section 5). The den box owner will determine the terms of monitoring that will ensure that the potential impact of disturbance is balanced with the value of the information collected.

If den box monitoring activity could lead to the disturbance of an animal and the information to be collected requires an approach within 5m of a den box, monitoring work must be carried out by a person with a pine marten disturbance licence obtained from the national SNCOs (eg, Natural England, NatureScot, Natural Resources Wales), or under the supervision of a person with a pine marten disturbance licence. Those without a disturbance licence or not under the supervision of a licenced person should not approach any closer than 5m to a den box in Scotland, England and Wales, taking all due care to minimise disturbance. Separate legislation applies in Ireland and Northern Ireland — to monitor den boxes in these regions, seek advice from national SNCOs.

This guide does not offer advice on legal constraints associated with monitoring a protected species. The permitted activity on a pine marten licence can vary across individual licences and different regions. It is your responsibility to ensure you are working within the bounds of your pine marten licence or under the supervision of a person with a pine marten disturbance licence.



Installing a trail camera to monitor a pine marten den box.

5 Minimising disturbance to denning pine martens

Unless it has been confirmed that a den box is unoccupied using a thermal imaging camera (see Section 7), approach the site assuming a pine marten is present and take all due care to minimise disturbance. Those without a pine marten disturbance licence must not enter within a 5m radius of a den box, unless directly supervised by a licenced surveyor.

The following steps can be taken to minimise disturbance

Keep group numbers to a minimum When essential to work in groups (such as for training purposes or during maintenance work), all persons present should stand silent and more than 30m from the den box — ideally downwind to reduce the risk of human scent reaching the den box and causing stress to animals. One person may then quietly approach the box to check it with a thermal imager, or up to two people may approach the box to install a trail camera, always in silence. A debrief, if necessary, should be done well away from the site and inside vehicles if possible.

Work quickly Pre-programme trail camera settings before approaching a den box and keep time on site to an absolute minimum — ideally less than two minutes. Where possible, plan a route to the den box in advance to approach quietly, directly and from downwind, avoiding unnecessary movement around the site.

Keep noise to a minimum Whisper if needing to speak and tread lightly. Close car doors quietly if parking on forest tracks near to den boxes.

Dogs Keep dogs more than 100m away from a den box or in vehicles if driving nearer to a den box on forest tracks.

Toilet breaks Do not urinate within 200m of a den box.

Camera servicing checks Revisits to the site to service the camera should be kept to a minimum. Typically, this should not be carried out more than once per month. Where there is evidence that a den box is being used for breeding (February-June), servicing visits should be reduced further wherever possible and avoided unless essential. When working in groups, all persons present should stay silent and more than 30m from the den box, ideally downwind. One person may approach the camera to service it.

Planning ahead Pine martens with kits will typically be present in dens between March and June. When monitoring den boxes for breeding, any maintenance or removal of visual obstructions required for the camera should be undertaken during the months of September and October.

There are currently two main types of pine marten den box widely used in Britain and Ireland (described below), as well as variations of these designs that feature similarly positioned entrance holes. A familiarity with these designs helps determine how to approach a den box, observe it with a thermal imaging camera, and effectively position a trail camera (see Section 10).

VWT-style den box

The VWT-style den box is the original design of the pine marten den box with a central denning chamber and chimneys on either side, providing good thermal insulation and a choice of entrances and exits for the occupants. This is the most common style of den box and the most effective trail camera position is at the rear, aligned with the entrance holes to capture entry and exit activity. Variations on this design include the Pine Marten Lite box, with a single chimney entrance beside the central chamber. Breeding and resting behaviour have been recorded in VWT-style den boxes (Birks J. & Martin J., 2023; Vincent Wildlife Trust, unpublished data).



VWT-style den box installation (left) , rear view of an installed box (centre) and internal view (right)..





Pine Marten Lite den box (©Wildlife Boxes).

Galloway Lite den box

The Galloway Lite den box is a smaller, lighter alternative to the VWT den box, which is typically better suited to smaller trees. It contains a smaller den chamber within a recycled plastic container and a single entrance and exit hole between the box and tree trunk. The Galloway Lite is often used in conjunction with VWT-style boxes installed in the same forest, providing pine martens with a network of safe resting and breeding dens. For this style of den box, the most effective trail camera positions are at the front or side, capturing the entrance and exit route. Breeding and resting behaviours have been recorded in Galloway Lite-style den boxes (Birks J. & Martin J., 2023; VWT unpublished data).

The Galloway Lite is no longer in production, but many boxes remain successfully in use across woodlands in Britain, including in its namesake region, Galloway Forest Park (Birks *et al.*, 2026; Croose *et al.*, 2024).



Galloway Lite den box.

Thermal imaging cameras provide a reliable, non-invasive method for assessing current occupancy of pine marten den boxes when used correctly (Martin *et al.*, 2022). If you do not have access to a thermal imaging camera, you must always take a precautionary approach and assume a den box is occupied. Approach it no closer than 5m unless under licence.

If you have access to a thermal imaging camera, before approaching a den box, thermal checks should start from as far away as possible (ideally >30m) to determine whether the den box is occupied. There is a risk that any close approach to an occupied den box may influence the behaviour of the occupant(s). Monitoring decisions should always involve considering the trade-off between impact upon the animal and the benefit gained from the information.

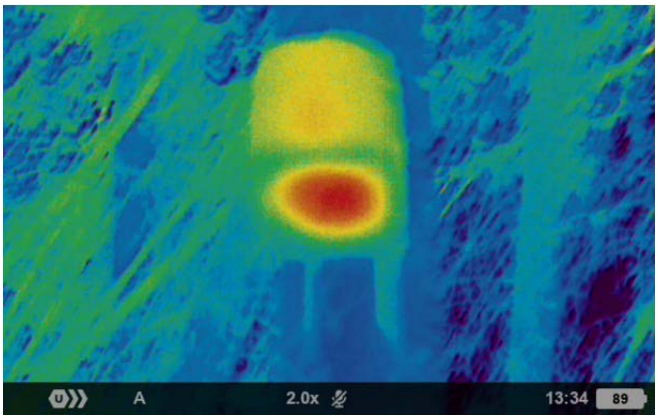
The most reliable method for determining current den box occupancy with a thermal imaging camera is to obtain an unobstructed view of the front and base of the box. However, thermal imaging is not without its limitations (see Section 7.6). False positives may occur where sunlight or other environmental factors create apparent heat signatures, or where other animals such as squirrels or nesting birds are present within the box. Conversely, false negatives are also possible — for example where a small single kit is present alone and does not generate a detectable heat signature. For these reasons, a precautionary approach must always be taken: any clear heat signature should be assumed to indicate the likely presence of a pine marten, while the absence of a detectable heat signature does not necessarily confirm that a box is unoccupied.

7.1 How thermal imaging cameras work

A handheld thermal imaging camera visualises the infrared radiation emitted by animals and objects, displaying temperature differences in various colour shades. It cannot see through surfaces, so when used to observe a den box, it displays the temperature of the box's surface. If an animal is inside, its body heat will usually create warm patches visible on the den box.

The reliability of interpreting a thermal image to confirm a pine marten's presence inside a den box depends on multiple factors, including the camera's specifications, settings, atmospheric conditions and viewing angle. The following sections explain how these factors influence detection, how to improve confidence in determining occupancy and best practice for approaching a den box.





Above Positive thermal images of VWT-style (left) and Galloway Lite (right) den boxes.





Right Unoccupied VWT-style (left) and a pair of unoccupied Galloway Lite den boxes (right).

7.2 Minimum recommended specifications

To make reliable observations with a thermal imaging camera, the equipment must meet minimum sensitivity specifications capable of detecting subtle temperature differences. The most important specifications are **Thermal Sensor Resolution** and **Noise Equivalent Temperature Difference**, which determine image clarity.

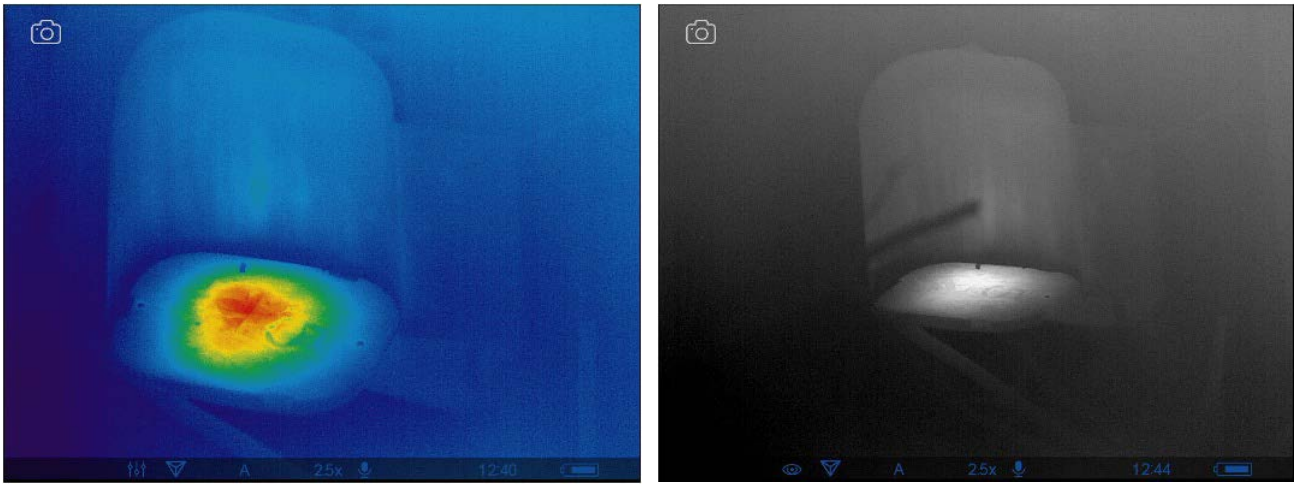
The following recommended specifications are made based on testing and expert experience.

Thermal Sensor Resolution The thermal sensor resolution should be **at least 320x240 pixels or higher**. This determines the level of detail in thermal images. Cameras with larger sensors (eg, 640x480 pixels) capture finer details and produce clearer images, improving the reliability of detection at longer ranges. Effective detection distance will vary considerably between camera models and according to environmental conditions (**see Section 7.6**).

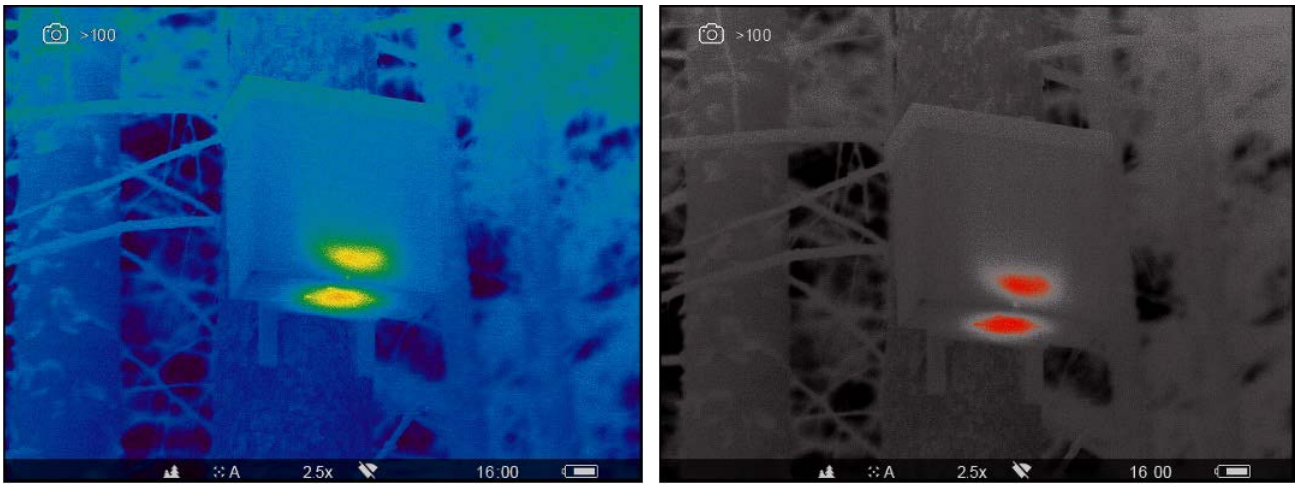
Noise Equivalent Temperature Difference (NETD) NETD should be **50 millikelvin (mK) or lower**. This measures the camera's ability to detect small temperature differences. A lower NETD value (eg, less than 40mK) indicates higher sensitivity, allowing the camera to capture finer heat variations. This results in clearer, more detailed thermal images, making temperature differences more pronounced and improving detection reliability.

7.3 Optimising thermal camera settings

Most thermal imaging cameras offer multiple colour palette modes, each displaying heat differently. High-contrast palettes, such as 'white hot' or 'black hot', usually provide the clearest distinction between hot and cold areas. If a heat signature appears faint, try switching palettes. Cycling through options can reveal subtle heat differences that might otherwise go unnoticed.



Positive thermal images of an occupied Galloway Lite den box showing a strong thermal signal with a 'rainbow' colour palette (left) and 'white hot' (right). Note that the thermal signal appears most prominently on the base of the box.



An occupied VWT-style den box in a 'rainbow' colour palette (left) and 'red hot' (right).

7.4 How environmental conditions affect detection

Certain environmental conditions can reduce the effectiveness of thermal imaging cameras, making it harder to distinguish temperature differences between a marten-heated den box and its surroundings.

Optimal environmental conditions Although dependent on camera specifications, clearer thermal images are typically produced on cooler days (below 15°C), because the temperature difference between a pine marten's body and its surroundings is more pronounced under these conditions. Images also tend to be clearer earlier in the day, before the den box has warmed up from direct or indirect sunlight. (**see Section 7.6**).

Sub-optimal environmental conditions Image clarity can be reduced under any of the following conditions: warm days (above 20°C), high humidity, rain, fog, or later in the day after the den box has absorbed heat from sunlight (which dissipates overnight).

In practice, conditions are rarely ideal and usually fall somewhere between optimal and suboptimal. Be mindful of these factors and exercise caution when interpreting thermal images.

7.5 Approaching a den box for thermal checks

Only one person should approach the den box using the thermal imaging camera — silently and from downwind if possible. All others should remain silent and stay more than 30m away, ideally downwind, to minimise disturbance.



Approaching a VWT-style den box at approximately 30m distance away.

First, consider the optimum viewing angle to observe a heat patch on the den box. For example, with Galloway Lite-style den boxes, approach the front or the side of the box. For VWT-style den boxes, approach the front of the box. The rear of the VWT-style box can also provide clear thermal images near the entrance holes, but is often more obscured.

Start approaching from the furthest point where the den box is visible. View the box through the thermal imager to check for a heat signature, then move forward several metres and check again, repeating the process on approach.

The final, crucial, step when 5m away from the box, is to crouch down to observe the base for a final check. This applies to any den box type and is often the most reliable view for detecting the presence of a pine marten. If the box has been approached from uphill, move to lower ground for better views, while maintaining a minimum 5m distance from the box. This is especially important when observing Galloway Lite-style den boxes, which contain a wooden box inside a plastic drum that provides insulation on the top and sides.

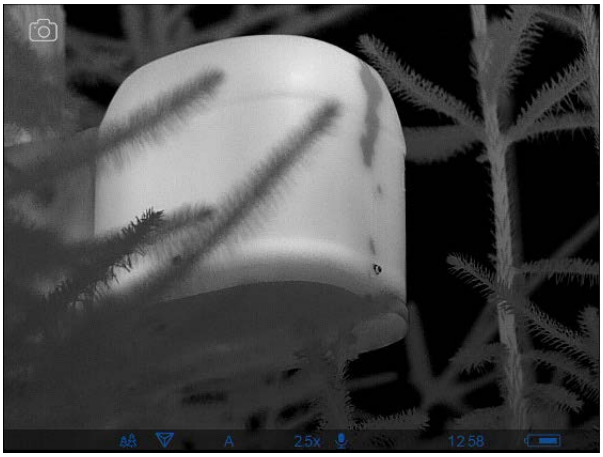
7.6 Thermal detection challenges

Certain heat patterns can be misleading when viewing a den box through a thermal imaging camera. The table below outlines common challenges in interpreting thermal images, with recommended steps to improve confidence in detecting pine marten presence.

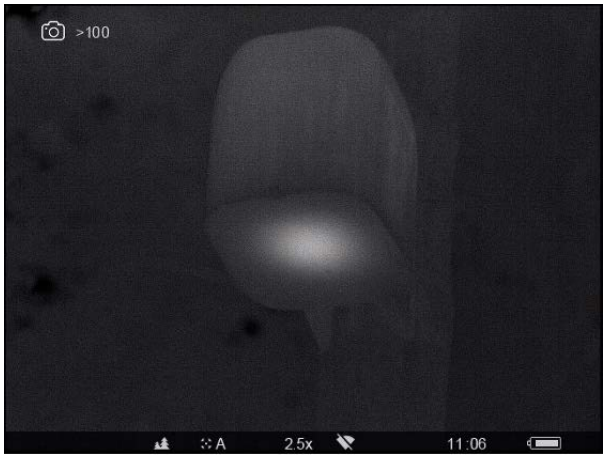
Table 1 Common challenges with interpreting thermal images of pine marten — and recommended steps.
This guidance has been generated from evidence gained through expert experience and testing.

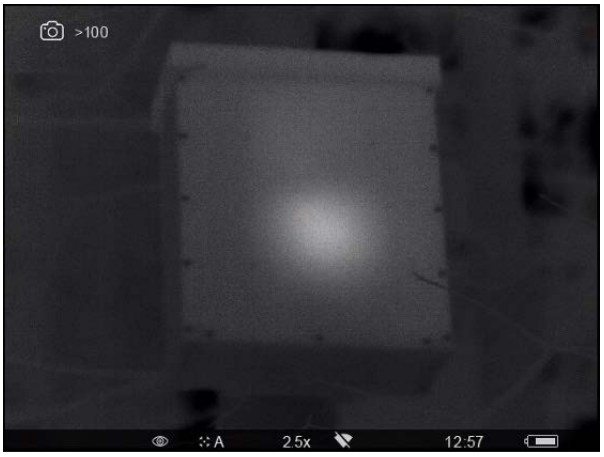
Observation type	Detection issue	How to assess
Marten Mirage A false signal caused by sunlight.	Solar loading occurs when a den box absorbs warmth from sunlight, directly or indirectly, causing the box to appear hot through a thermal imaging camera. In this instance, the whole box may appear hot, or smaller patches appear hot due to dappled sunlight.	The most reliable check in this situation is the box base: an animal present will usually create a round warm patch that does not fully cover the wooden base. Sunlight is unlikely to warm the base in this way.
Thermal Imposter Other heat sources mimicking pine marten occupancy.	A false pine marten positive may occur when other species (eg, squirrels or nesting birds) or objects (eg, decomposing food or stashed items) produce a heat signature resembling that of a pine marten.	Approach the box as though a pine marten is present (see Section 5 on minimising disturbance).
Masked Marten No heat source detected, even though a marten is present.	A false negative may occur when a pine marten is present in a den box but is not detected. This can happen for several reasons, including insulating materials such as squirrel drey material; the presence of a small pine marten kit on its own that produces insufficient heat to warm the sides of the box; suboptimal atmospheric conditions (eg, higher ambient air temperature); or the use of a thermal imager that does not meet the minimum recommended specifications.	If there is any uncertainty, follow the precautionary principle and treat the den box as occupied. If further confirmation of occupancy is required, install a trail camera in line with the guidance in Section 10. Field signs such as scats on the lid (viewed through binoculars from >5m) or on the ground nearby may indicate recent use, but they do not confirm current occupancy.
Thermal Anomaly	When a den box is occupied, heat from the animal may be retained and transmitted unevenly through the timber, with knots often appearing as small, discrete hot spots (Martin, 2023). These can be misinterpreted as multiple animals or kits generating separate heat sources.	Interpret small, isolated hot spots with caution and consider the overall heat pattern across the box. These anomalies should not be used to infer the number of animals present.

As thermal imaging technology advances and practitioners gain more experience, the reliability of thermal assessments of den box occupancy will continue to improve. This guidance will be updated to reflect new insights and to ensure that best practices are followed.



Marten Mirage Solar loading of a Galloway Lite den box on a warm day has caused the whole outer shell to appear hot when using the 'white hot' colour palette. Note the lack of a warm patch on the base.





Thermal Imposter (left) A grey squirrel in a Galloway Lite den box, confirmed by subsequent trail camera footage. The size and intensity of a heat signature can vary greatly depending on the species present, environmental conditions and the specifications of the thermal camera.

Thermal Imposter (right) A grey squirrel inside a VWT-style den box. Drey material prevents a warm patch appearing on the base; instead, heat is detected higher within the chamber due to the build-up of material. Heavy rain has also reduced image clarity.



Thermal Anomaly Photograph of the base of a VWT-style den box (left) and corresponding thermal image (right) following controlled warming with two hot water bottles at 35°C (Martin, 2023). Brighter white indicates higher surface temperature, particularly at timber knots.

While a thermal camera provides the most reliable way to assess whether a den box is currently occupied, the absence of a heat signature does not necessarily mean the box is unused or has not been used recently. Several field signs can indicate pine marten activity, but none confirm current occupancy.

Scats on the den box

Pine martens sometimes leave scats on the top of den boxes, and their presence can suggest that a box has been recently used. However, this is not a dependable indicator of current occupation — many confirmed cases of pine martens inside boxes show no scats on top at all. The box top can be checked with binoculars from a distance (ideally >30m), preferably from elevated ground for a clear view.





Pine marten scats on top of a VWT-style den box (left) and a large pile of scats on a VWT-style den box, visible from a distance (right). This quantity of scats is typical of a box in use over several weeks by a breeding female pine marten.

Scats on the ground

Pine martens may also scat on the ground near to, or directly beneath, a den box. This sign can help indicate use, but should be examined closely only after a thermal camera assessment has confirmed that the box is not currently occupied, as it requires a close approach within 5m of the den box.

Feeding remains underneath the den box

If a marten is resident, there will sometimes be the remains of prey discarded below or in the vicinity of the den box.

Claw marks and polished branches

Repeated use of a den box by pine martens can result in smooth, polished bark and visible claw marks on branches leading up to the box. While these signs can point to regular use over time, they do not indicate how recent that use was as marks can remain from previous seasons. Other species, such as grey squirrels, can create similar wear. As with ground checks, this assessment should only be made once a thermal camera check has confirmed that the box is unoccupied.



Examples of branch 'polishing' caused by repeated use of the branch by a pine marten.

9 Choosing a suitable trail camera

Trail cameras offer a practical way to monitor pine marten den boxes recording use, breeding success and behaviours without causing disturbance. The recommendations in this section are based on field testing and the practical experience of surveyors — and explain how to select and configure a camera for reliable monitoring.

9.1 Important trail camera features

There is a wide selection of trail camera models available that will suit den box monitoring. When choosing a camera, there are several key features to look out for.

Clear video Look for sample footage from cameras online to gain a sense of image clarity. While two different cameras may offer the same resolution, the resulting picture clarity can appear very different. Look for a camera that produces clear daytime footage in colour and clear night-time footage using infrared light (black and white).

Infrared night footage Infrared LEDs produce clear black-and-white images in low-light and night conditions without disturbing pine martens, which cannot see this wavelength. Infrared LEDs are the standard flash type used in trail cameras. Avoid using cameras with incandescent or white flash, as these will cause disturbance.

Fast video trigger A 0.5 second trigger or less for video is sufficient to capture any quick activity. Note that video trigger speed and photo trigger speed are usually listed as different speeds by manufacturers.

Preview screen A built-in preview screen showing what the camera can see enables users to easily check camera aim on the target area during installation. This is especially important when monitoring den boxes — a well-aimed camera is much less likely to miss activity.



Trail camera in position.

9.2. Recommended trail camera settings

The following recommendations for trail camera settings apply to typical monitoring scenarios for den box use, breeding and kits, and observing behaviours. Camera settings should always be configured away from the den box site to reduce disturbance.

Date/time stamp Ensure the camera's date and time are set correctly before installation. Accurate timestamps are essential for interpreting behaviour, identifying repeat visits by the same animal, and comparing activity across multiple sites. A quick double-check prior to installing a camera can prevent loss of valuable context later. Consider that some camera manufacturers use the American date format MM/DD/YYYY.

SD card formatting To reduce the risk of corrupted files or recording errors during monitoring, always format the SD card inside the camera before deployment. This is achieved by selecting either 'Delete All' or 'Format' (or similar) in the camera settings. Avoid formatting on a computer as some cameras require internal formatting to record reliably.

Video mode Set the camera to video mode to help with determining behaviours such as whether a box is entered or exited by a pine marten. Some trail cameras also record clear audio on video mode, which may occasionally provide additional information about activity occurring within or around the den box (eg, young kits vocalising inside the box).

When to use photo mode Although it is harder to confirm behaviours when a camera is in photo mode, this can be a useful option if a camera is left monitoring a den box for long periods without servicing (eg, more than three months). The smaller file size of photos coupled with greatly reduced demand on battery power means that many modern trail cameras will comfortably run unattended for three months or more in photo mode. In this scenario, it is recommended to set the camera to capture five photos per trigger to help capture sufficient information.

Recording duration Twenty seconds of video per trigger normally captures sufficient information for each event without capturing excessive amounts of empty footage.

Picture/video delay Use the shortest delay option between image captures so that the camera is ready to record again as soon as it detects an animal. Cameras will typically have an option for no delay or a one-second delay between captures.

Trigger sensitivity Use the highest sensitivity option on the camera. This is especially important for the type of medium-long range setups described in this guide, helping the camera trigger as soon as an animal is detected. On some Browning trail cameras, trigger sensitivity is controlled by the Detection Range setting — select Long Range for highest sensitivity.

Capture timer If a camera has a capture timer option, set this to all day — it may pick up pine marten footage night and day.

Battery type Many trail cameras are compatible with different types of AA batteries. If available, ensure the battery-type setting matches the type of battery being used for reliable performance.

9.3 Memory card

It is always hard to predict how active a den box will be. Ensure there is sufficient memory card space to record any activity over the time the camera is installed. For example, a 32GB memory card should be more than sufficient if the card is changed every two months. Choose a Class 10 or U1/U3 SD card, as slower cards can struggle to save video reliably.

9.4 Batteries

Batteries are the number one cause of issues with trail cameras. The type and brand of batteries used determines how a camera performs.

Lithium batteries These are the best option as trail cameras require bursts of power to work as intended. For this reason, lithium batteries work best and provide the longest life. Energizer Ultimate Lithium AA batteries are a tried and tested reliable option.

Rechargeable batteries These can have mixed results. Only use rechargeable batteries that are specifically recommended by the camera manufacturer or the retailer from which the camera was purchased. NiMH rechargeable batteries can be variable in performance and, in some cases, may not work at all. Many camera models will either not operate or will function only partially when using rechargeable batteries.

Avoid alkaline batteries Alkaline batteries are not recommended for use in trail cameras as they provide inconsistent power and work poorly in colder temperatures, losing up to half their capacity in sub-zero temperatures.

Never mix batteries Mixing different battery types or brands carries a high risk of the trail camera failing to trigger. A camera may appear to switch on and operate normally, but when higher bursts of power are required — particularly for night-time recording — it may respond slowly or fail to record altogether.

9.5. Trail camera security

Depending on location, consider using a cable lock for trail camera security. Where a den box is close to a path or road, cameras may be easier to spot by passers-by. Many trail cameras will have holes in the housing that fit the commonly used Master Lock 8mm (1.8m long) Python cable lock.

When leaving a camera locked to a tree for long durations, loosen the lock every six months. Tree growth can tension the lock over time, causing it to jam.



Trail camera secured with a cable lock.

There is no ‘one-size-fits-all’ trail camera setup for monitoring a den box. The approaches described here reflect tested practice developed through field use, and are intended to support reliable monitoring with minimal disturbance to pine martens.

An effective trail camera setup is one that triggers reliably and captures clear images. Trail cameras are designed to detect animals moving across the ground. When monitoring a den box, the target area is elevated and the camera must be positioned accordingly. The following guidance is a series of considerations for setting up a trail camera effectively for den box monitoring.

Where new den boxes are being installed and monitoring is planned, identify both the den box tree and the intended trail camera position at the time of installation. Doing so ensures that suitable trees are selected from the outset and helps support effective long-term monitoring. An unobtrusive marker on the trail camera tree can help with quickly locating it on return visits to minimise disturbance.

10.1. Field of view

Objective – Select the most effective view to capture a pine marten entering and exiting a den box.

Choose the angle that best shows the entrance you need to monitor. Bear in mind that a single camera will always have blind spots as it can only cover one side of the den box and tree.

For VWT-style den boxes with two entrances on the rear, position the camera to face the rear of the box so that it can record pine martens entering and leaving.



Trail camera view of a VWT-style den box with two entrances.



VWT-style den box with two entrances.

In many situations it is not possible to aim directly at the back of a VWT-style box due to limited options of trees to attach a camera to, rendering one of the entrances partially or completely obscured. Where this is the case, maintain a distance of 5m from the den box and look for field signs to indicate which side of the box the animal is most likely to enter, based on climbing opportunities created by branches below the box. Binoculars are a useful tool for checking for field signs from a distance.

In some cases, claw marks and polished surfaces on branches near the trunk (see Section 8) can indicate the route an animal uses to access a den box. However, observing these signs requires approaching within 5m of the box. This should only be done after confirming with a thermal imager that the box is unoccupied, or if you are working under a disturbance licence or under the supervision of a licence holder.



Offset views of VWT-style den boxes.

When monitoring a Galloway Lite-style box or a similar design with a single entrance between the den box and tree trunk, aim the camera at the front or to the side of the box to see pine martens entering and exiting.



Side view of a Galloway Lite den box.

Where possible, avoid positioning the camera so that it captures large areas of sky or faces directly towards sunrise or sunset, as this can cause over-exposure and lens flare.

10.2 Distance

Objective — Select a tree for the camera installation at a distance that minimises disturbance to pine marten(s) occupying the den box and captures clear images.

Select a tree for camera installation 5m from the den box. At this distance, the camera captures a balanced view of the den box and its surroundings, producing clear, in-focus footage. Those without a pine marten disturbance licence should not approach closer than 5m, and those with a licence should consider whether the potential additional disturbance to the animal is worthwhile within the 5m range.

If a den box was not installed with a dedicated trail camera tree in mind, there may be no suitable trees exactly 5m away. In this case, select a tree within 5–8 m of the den box. Beyond 8m, image detail is reduced and the field of view becomes wider, increasing the likelihood of obstructions such as branches between the camera and the den box.

Most trail camera models begin to lose focus when placed closer than 3m to a den box. At this distance, the field of view is also much narrower, limiting the behaviours that can be captured, such as box entry and exit routes. Unless you are working under a disturbance licence, do not install a trail camera closer than 5m to a den box, even if it has been confirmed as unoccupied using a thermal imager. When returning to service or collect the camera, the box may be occupied and a close approach risks disturbance and a legal offence.



Trail camera aimed at a VWT-style den box.

10.3 Height and aim

Objective — Install the camera at a height where at least the bottom half of the den box is visible in images, with the field of view centred below or on the entrance(s) to the den box.

Always position the camera at a height where it can still be serviced while attached to the tree, making set up and later servicing quicker and easier. Ladders should not be used to install a trail camera, as this increases the risk of disturbing a pine marten occupying the den box. Capturing the whole den box in the field of view is often not possible due to the height that some den boxes are installed. Capturing at least the lower half of the den box in the field of view will still provide clear evidence of pine marten entrances and exits.

Aim the camera so that the field of view is centred below the box on the tree trunk or directly on the entrance(s). This ensures the camera triggers quickly and reliably when an animal enters the frame. Avoid including loose branches or foliage within the field of view, as these may cause false triggers during windy conditions. If minor pruning is required to achieve a clear field of view, this should be carried out during den box installation or routine maintenance visits, and never while a box is occupied.

Always check camera aim using the preview screen or through test images.

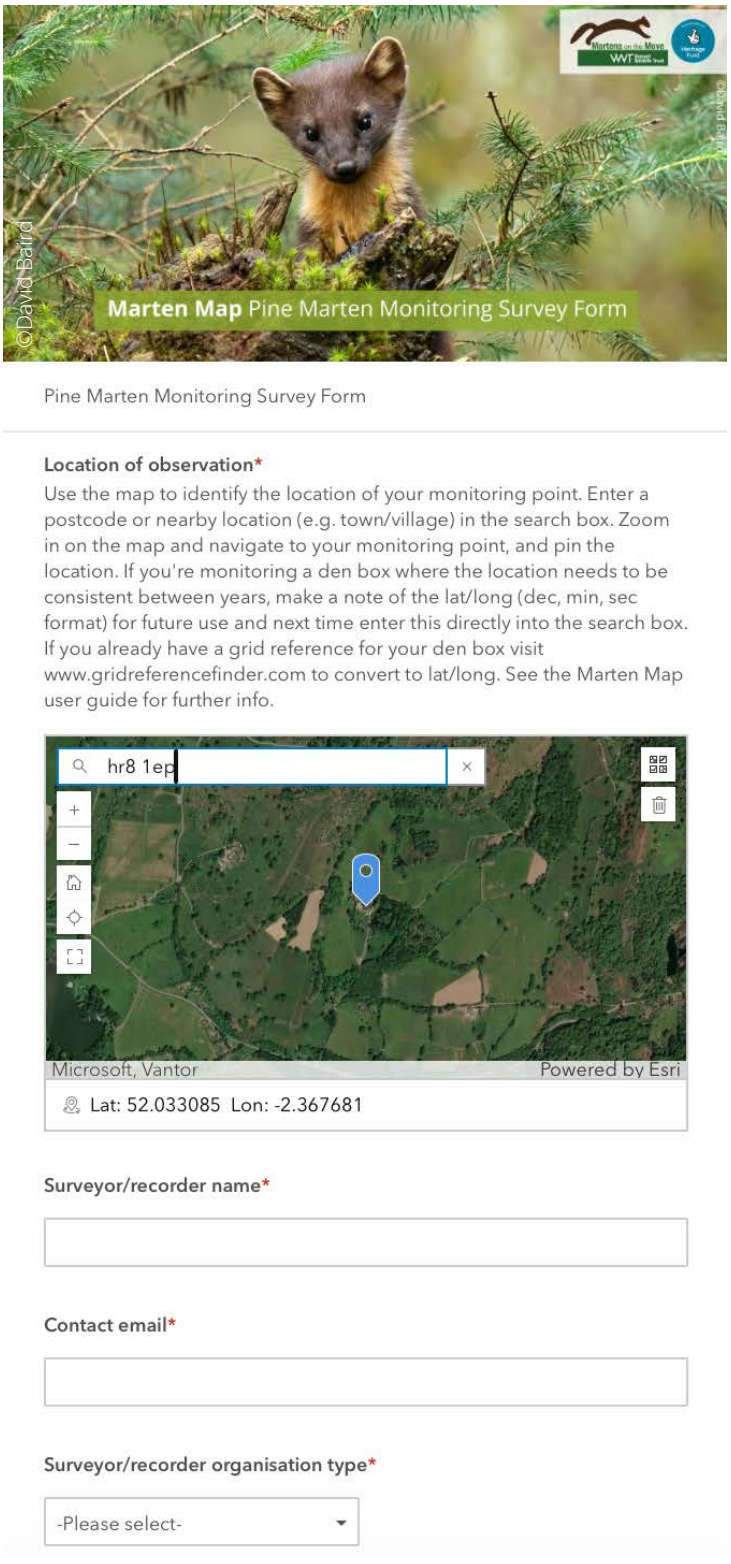


Aiming the camera directly at or below den box entrances helps with reliable camera triggers. The red zone illustrates the intended target area. Cameras do not typically provide an on-screen aiming guide — this overlay is for demonstration only.

10.4 Camera angle

In most scenarios, the camera should be mounted flush against the tree. Angling the camera upwards toward the den box is not recommended, as rain or snow can collect on the front of the camera and obstruct the field of view, and potentially shortening its lifespan due to water ingress. Trail cameras are water-resistant, not waterproof.

Records collected through den box monitoring can make an important contribution to our understanding of pine marten distribution, breeding success and den box use. Surveyors are encouraged to submit records to Vincent Wildlife Trust's National Pine Marten Monitoring Programme, where they can contribute to a wider evidence base supporting pine marten conservation. Visit https://pinemartens.uk/national-pine-marten-monitoring-programme



VWT's National Pine Marten Monitoring Programme data recording form.

Following many years of collective experiences of monitoring pine martens, we have found the following situations are common challenges, which we hopefully have found some solutions for. Please feel free to share your solutions!

1 It is challenging to find a suitable tree to attach a camera to.

The camera installation recommendations provided in this guide are best-case scenarios, but options for trees to attach a camera to may be limited, and no two locations will be identical. Well-thinned stands of more mature trees typically result in longer range setups (up to 8m), whereas denser, younger stands result in medium range setups (from 5m). So long as the camera is well aimed, medium and long-range setups can work effectively.

Where new den boxes are being installed, both the den box tree and the trail camera tree should be selected together. At the time of installation, carry out work to remove obstructions to the view, such as branches.

2 There are no suitable camera installation trees within the 5-8m range of the den box.

Option 1 Consider options to view the box from different angles. If it appears that the best climbing route for a pine marten into a VWT-style box is on one side of the tree, aim the camera at that side of the box.

Option 2 If resources allow, use a second camera from an alternative angle on a different tree.

Option 3 Choose a longer-range setup. Check the detection range of the camera model in the user manual — many modern trail cameras will be able to capture clear images up to 10m, although at this range detail is lost and there will likely be more obstructions between the camera and box.

Option 4 If the camera has a tripod mount, consider using a telescopic bank stick with a camera tripod mount adaptor.

3 There appear to be recent signs of den box use (eg, fresh scats on top or a thermal signature) but there is no footage recorded on the camera.

Preliminary step Replace batteries with fresh ones and ensure the SD card is formatted inside the camera (not in a computer) to avoid recording issues.

Camera adjustments

Option 1 Adjust the height and angle of the camera, ensuring it is centred directly below or on the den box entrances.

Option 2 Attach the camera to a different tree to observe the box from an alternative angle.

Option 3 Consider a secondary ground-level camera. Installing a second trail camera aimed at the base of the den box tree, either from the same tree or a different angle, provides a backup view of animal approaches. This will not show animals entering the box, but it can help verify whether the primary elevated camera is capturing activity effectively.

4 It is difficult to see the detail of a pine marten bib pattern at 5m.

It is challenging to reliably capture the detail of a pine marten's bib pattern when monitoring den boxes. While very clear footage may occasionally show a bib pattern if the animal positions itself optimally, this should be considered a bonus piece of information rather than an objective of den box monitoring. More reliable approaches to recording pine marten bib patterns require a different approach well away from den boxes, involving bait stations and close-range camera settings.

13 References

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www.vwt.org.uk

Vincent Wildlife Trust (VWT) is an independent charity and a leading mammal conservation organisation with a track record of delivering high-quality wildlife interventions, based on scientific evidence. It is respected internationally for its research and innovative evidence-based ways of halting and reversing declines in mammal populations, including the otter and pine marten.

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