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# A cost-effective basking trap design for invasive turtle management

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One of the main drivers of biodiversity loss is the spread and impact of invasive species, which can rapidly alter ecosystems and outcompete native species (Pyšek et al., 2020). Consequently, effective wildlife management often requires strategic control or eradication efforts aimed at invasive species (Hulme, 2006). However, management actions frequently face significant constraints due to limited budgets, restricting the availability and implementation of certain control methods (Epanchin-Niell and Hastings, 2010; Wenger et al., 2018). While cost-effectiveness analyses aid in identifying feasible management options (Firn et al., 2015; Epanchin-Niell, 2017), further reducing the costs of these control methods, without compromising their effectiveness, could expand the range of viable management strategies included in these assessments (Kerr et al., 2016).

In efforts to manage invasive turtle species, particularly the pond slider, *Trachemys scripta* (Thunberg in Schoepff, 1792), widely recognized as one of the world's most invasive reptiles (Lowe et al., 2000; Cadi and Joly, 2003), trapping is the most commonly employed control method (Mali et al., 2014). Typical trap types include minnow traps, fyke traps, and Aranzadi Turtle traps (hereafter simply 'basking traps') (Valdeón et al., 2010). Minnow traps rely on bait to attract turtles actively engaged in foraging, whereas fyke traps can additionally function as passive interception devices when strategically placed along movement corridors (Hubert et al., 2012). In contrast, basking traps exploit the natural behaviour of turtles seeking sunlight and warmth (Gamble, 2006). By leveraging this instinctual basking behaviour, these traps may provide a complementary approach capable of capturing turtles that may temporarily prioritize basking over feeding, thereby potentially increasing overall capture success (Gamble, 2006).

A further advantage of basking traps lies in their open-top design, which significantly reduces the risk of turtle asphyxiation or drowning, a potential hazard of minnow and fyke traps if these become damaged or submerged. However, while minnow and fyke traps are commercially produced, widely available, and relatively inexpensive, basking traps are less readily available, typically sold only by specialized companies, and at approximately 10–30 times the cost (based on prices sourced from online stores Outdoor Water Solutions and Pond King in October 2025). Due to their limited commercial availability and high cost, many wildlife managers opt to construct basking traps themselves. Although building traps reduces the overall cost, the expenses associated with necessary materials may still restrict the number of basking traps that can feasibly be deployed in invasive turtle management programs.

Traditionally designed basking traps are constructed with floating frames composed of materials such as styrofoam, wood, or PVC piping, supporting suspended baskets made of netting or hardware cloth. Among these components, the cost associated with PVC piping often presents a notable barrier, restricting the widespread implementation of basking traps (Gamble, 2006; Valdeón et al., 2010).

To address this limitation, we here propose a novel, cost-effective basking trap design intended to markedly reduce material expenditures and provide a comprehensive, step-by-step guide detailing the assembly of these modified traps. Additionally, we conducted a comparative evaluation between our

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modified basking trap design and the conventional PVC-based trap model. This comparative analysis sought to determine the relative effectiveness, capture efficiency, and overall performance of our reduced-cost trap design, ensuring that lower material costs do not compromise the effectiveness of invasive turtle management initiatives.

## Materials and Methods

**Trap construction.** We assembled one alternative trap (Fig. 1A) by cutting a 200 × 100 × 2 cm polycarbonate panel (often used for greenhouse construction) into eight equal pieces (25 × 80 cm). Four of these pieces formed an 80 × 80 cm square with 25 cm high walls, connected

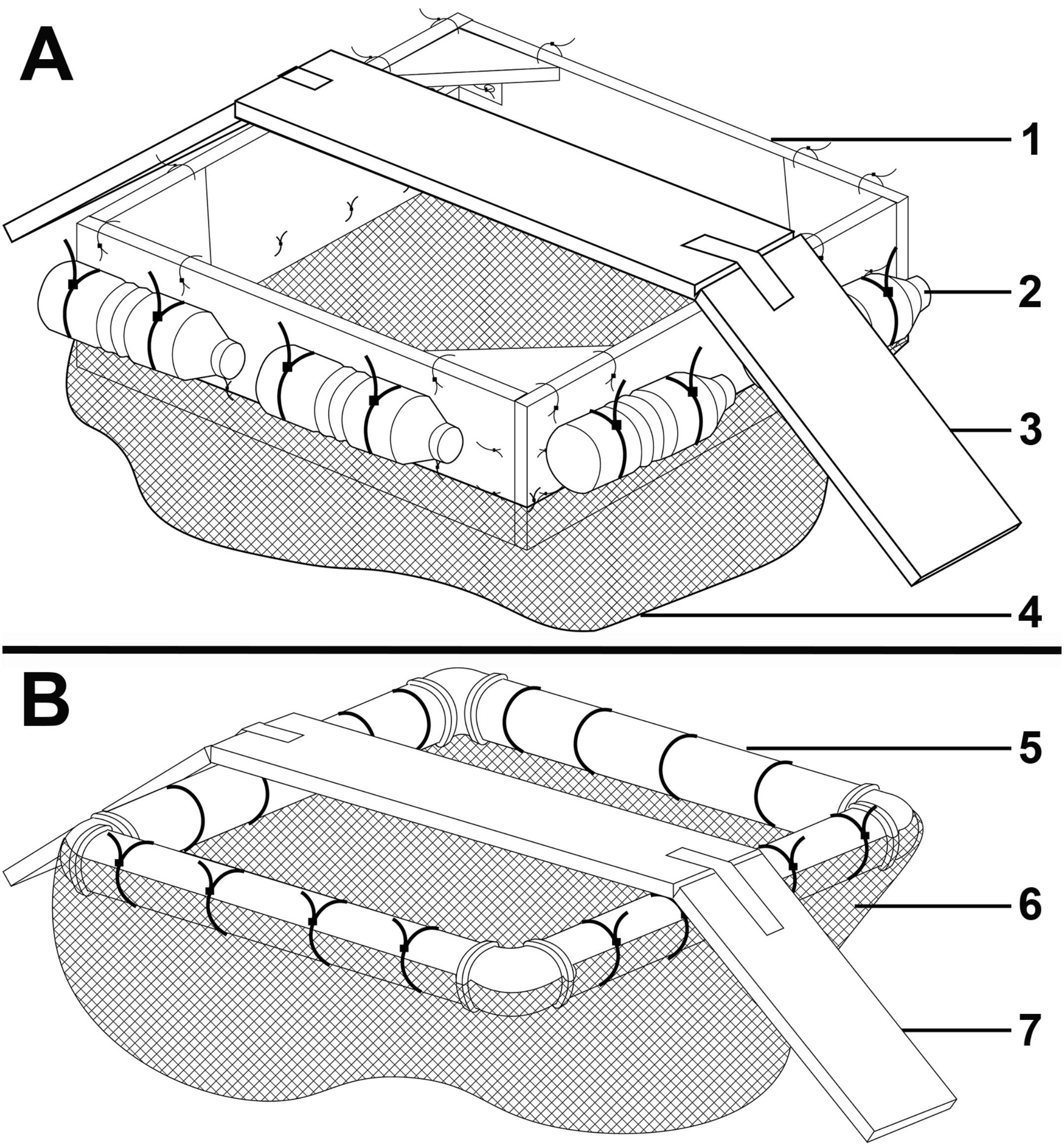


**Figure 1.** (A) A schematic of the alternative basking trap. The polycarbonate panels (1) form a square with vertical walls. The attached PET bottles (2) provide buoyancy. A net (4) prevents the escape through the bottom of the trap. A wooden ramp crossing the trap (3) attracts turtles for basking. (B) A schematic of the traditional basking trap. The PVC tubing (5) forms a square to provide both buoyancy and preventing turtle escape. A net (6) prevents the escape through the bottom of the trap. A wooden ramp crossing the trap (7) attracts turtles for basking.

using L-shaped metal brackets. Four triangular pieces (25 cm sides at a right angle) reinforced the corners to prevent turtle escapes and enhance stability. A 100 × 100 cm nylon net with mesh size 0.8 × 0.8 cm was securely attached to the outside bottom of the square using cable ties through pairs of holes along each side. Additionally, eight holes per side allowed the attachment (via cable ties) of two 1-l plastic bottles for flotation. A separate wooden ramp, consisting of two 50 × 15 × 2 cm planks attached with wood screws on a bent L-shaped metal brackets at a 135-degree angle to an 80 × 15 × 2 cm central plank, was positioned on top of the trap during deployment. A detailed blueprint with a full parts list and step-by-step assembly instructions is provided in the Appendix. Excluding tools and labour costs, the material costs for one alternative trap were approximately EUR 40, for purchases made in retail stores in Évora, Portugal, in May 2025.

For comparative purposes, we assembled a basking trap using four lengths of 1-m-long, 10-cm diameter PVC tubes joined at the corners with PVC fittings and PVC glue. A 100 × 100 cm nylon net, with mesh size 0.8 × 0.8 cm, was similarly attached using cable ties on the outer side of the tubing to ensure it did not offer an escape route. The ramp design was nearly identical to that of the alternative trap, although the bridge section was 1 m instead of 80 cm long, and was positioned atop the frame during deployment (Fig. 1B). Excluding tools and labour costs, the material costs for the traditional trap were approximately EUR 110 per trap, for purchases made in retail stores in Évora, Portugal in May 2025.

**Field study.** We assessed the traps' performances at Lagoa Azul, Sintra, Portugal, a site with a high density of invasive and non-native turtles (Rato et al., 2026). From 9–15 July 2025, we simultaneously deployed one traditional and one alternative basking trap to evaluate their comparative effectiveness. Additionally, from 15–19 September 2025, we placed the same two basking trap designs but switched their positions to account for differences in location. On both occasions, the traps were positioned approximately 10 m from the shoreline and 20 m apart to avoid nearby familiar basking sites that turtles might prefer, and to ensure both traps were accessible to the same individuals, minimizing spatial bias. Each trap was anchored using a rope tied to a submerged rock, which allowed slight movement due to wind or water current. As a result, spacing varied slightly between days. Both traps were monitored daily, and a camera trap was installed on the alternative basking trap to document turtle interactions (Fig. 2). Captured turtles were identified to species level and their straight carapace length was measured to the nearest 0.1 cm using Vernier callipers.

**Data analysis.** Capture data from the July and September 2025 field sessions were pooled for analysis. Total captures were compared between trap types using a chi-square test. Mean daily captures were calculated for each trap type and session. Daily capture rates were analysed using a Poisson generalized linear model with

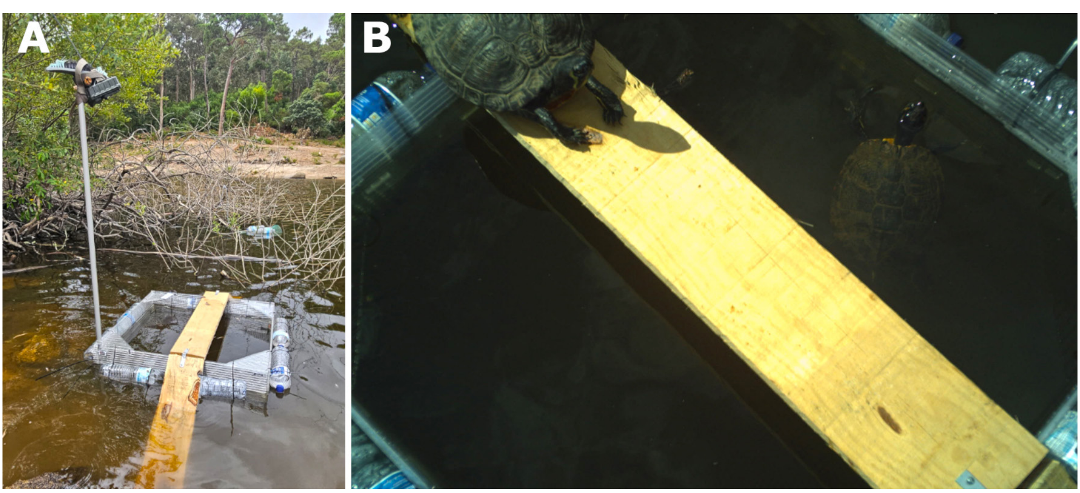


**Figure 2.** (A) Alternative basking trap with mounted camera trap. (B) Camera trap footage of one basking *Trachemys scripta* and one *T. scripta* inside the trap. Photos by Shaquille Matthys.

trap type and trap position as explanatory variables. Model fit was assessed using residual deviance and Akaike's Information Criterion (AIC). Differences in species composition between trap types were assessed using Fisher's Exact Test, and mean carapace length was compared using Welch's two-sample *t*-test. One *Graptemys pseudogeographica* (Gray, 1831) individual captured in the traditional trap was omitted from the carapace length analysis because its carapace length was not recorded. All analyses were conducted in R Statistics Software v4.4.2 (R Core Team, 2024).

**Results**

Over the course of two field sessions (six trapping days in July, four in September) we captured a total of 25 turtles using two basking trap designs deployed at alternating positions. Turtles were frequently observed basking on both trap types during the trial (Fig. 3), although basking behaviour did not always result in capture. The traditional basking trap design captured a total of 15 invasive turtles, comprising two *T. scripta* and 13 *G. pseudogeographica*. The alternative trap design captured ten invasive turtles, including three *T. scripta* and seven *G. pseudogeographica*. A chi-square test comparing total captures showed no significant difference in performance between the two trap types ($\chi^2 = 1.00$, $df = 1$, $p = 0.32$). Although the native turtle species *Mauremys leprosa* (Schweigger, 1812) was confirmed to be present in the pond, neither one of the basking traps resulted in the capture of this species.

Mean daily captures were higher for the traditional trap in both sessions, with 1.33 turtles per day for the alternative trap and 1.67 turtles per day for the traditional trap in July, while in September, the alternative trap averaged 0.50 turtles per day, and the traditional trap 1.25 turtles per day. Across both sessions, capture numbers ranged from 0–4 turtles per day. A Poisson generalized linear model accounting for trap type and physical position showed no significant effect of either factor on daily capture rates. The traditional trap had a higher estimated daily capture rate than the alternative (rate ratio = 1.55, $z = 1.05$, $p = 0.29$), and Position B showed no significant difference from Position A (rate ratio = 1.18, $z = 0.41$, $p = 0.68$; residual deviance = 20.26, $df = 17$, AIC = 61.35).

We also tested whether the species composition of captured turtles differed between trap types. A Fisher's Exact Test showed no significant difference in species composition between the two trap types ($p = 0.51$), suggesting that there was no trap type preference for either species.

Mean carapace lengths were nearly identical between turtles captured by the two trap types. Individuals caught in the alternative trap had a mean carapace length of 15.6 cm ($SD = 2.17$, $n = 10$), while those caught in the traditional trap had a mean of 15.9 cm ($SD = 2.32$, $n = 14$). A Welch two-sample *t*-test indicated no significant difference in mean carapace length between the two trap types ($t = -0.32$, $df = 20.3$, $p = 0.75$, 95% $CI$: -2.23–1.63).

**Discussion**

Based on our field site tests, we found no significant difference between the effectiveness of the traditional and alternative basking trap designs, highlighting the cost-saving potential of the modified approach. Despite the limitation inherent to our small sample size, the key takeaway is that both trap types successfully attracted and captured turtles, suggesting that either design can be effectively used in turtle management. Notably,

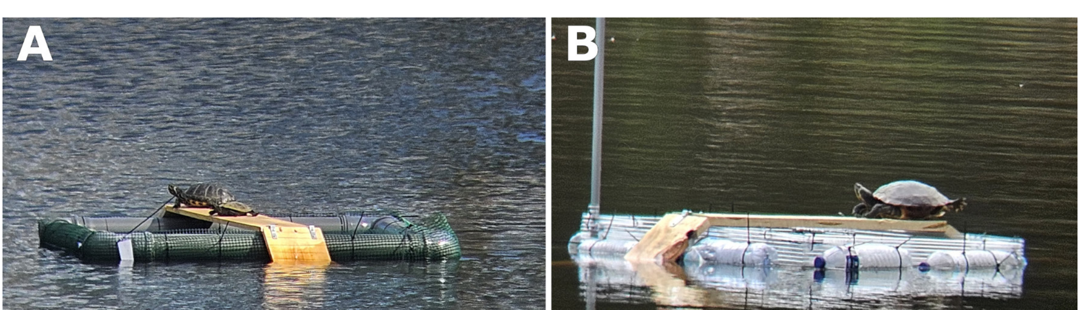


**Figure 3.** (A) Turtles basking on the traditional basking trap design. (B) Turtles basking on the alternative basking trap design. Photos by Shaquille Matthys.

the alternative trap design is significantly more cost-efficient: for the cost of one traditional basking trap, two alternative traps can be constructed.

This difference can allow management to double their trapping effort at a single site or enable them to target more locations concurrently. It may also be preferred in short-term interventions, such as pilot studies where minimal investment is desired. In contexts where vandalism or tampering by anglers or activist groups is a concern, the lower cost of the alternative trap may also reduce financial loss in the event of damage or theft.

In addition to cost, the alternative trap offers practical advantages in certain field scenarios. Its materials are generally lighter and easier to transport, making it suitable for remote sites where access is limited. Although the heavier weight of the traditional basking trap results from its sturdier construction, making it less prone to structural damage, if a PVC tube is punctured, the entire tube can flood, rendering the trap heavy, difficult to repair, and unusable until drained. In contrast, the flotation system of the alternative trap design, individual plastic bottles, is modular and easily replaceable. Even if one bottle is compromised, the entire trap does not necessarily sink.

The observation that basking behaviour did not always result in capture suggests that some turtles may leave the platform by moving back down the ramp instead of dropping into the net. Some trap designs incorporate tipping or pivoting ramps that drop when a turtle climbs onto them, causing the animal to fall directly into the capture net (as available in the online store Outdoor Water Solutions in October 2025). Such a mechanism could potentially be incorporated into the alternative trap described here to increase capture efficiency. However, it is not included by default in most traditional basking traps either and therefore not an inherent shortcoming of our alternative design.

During the study period, no damage or signs of material decay were observed on either trap type. Notably, the alternative trap showed no visible wear even during anchoring and retrieval, when traps are typically handled more roughly. However, given the short duration of the trial, the long-term durability of the alternative trap design remains to be tested. In conclusion, further studies with larger sample sizes and across diverse locations are recommended to better assess the performance, reliability, and potential biases of each trap design.

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**Appendix.** Blueprint and assembly guide for the alternative basking trap described in this study. The diagram includes a parts list (top right) and step-by-step instructions for cutting, assembling, and outfitting the trap with flotation bottles and ramp. Illustrations were created using Adobe Illustrator.