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Citizen science perceptions into the distribution and impacts of the Common Myna (*Acridotheres tristis*) in Jordan

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The Common Myna (*Acridotheres tristis*) is a globally recognized invasive alien species with documented ecological and social impacts. This study employed a citizen science approach to investigate the distribution and perceived ecological and economic effects of the Common Myna in Jordan. An online questionnaire yielded 201 valid responses from all 12 governorates, of which only 50.2% of respondents who recognized the species were included in the subsequent data analysis. Reports from 113 localities indicated that the species is concentrated in urbanized areas of northwestern Jordan. Increased sightings since 2019 suggest population growth and continued expansion across human-modified landscapes. Increased occurrences near protected and in agricultural areas raise ecological concerns. Respondents identified competition with native birds as the main impact, while effects on crops and human health (*e.g.*, noise) were perceived as minor. Urban expansion and food waste were viewed as key drivers of the spread. Beyond data collection, the survey also functioned as an awareness tool, highlighting the dual value of citizen science for both monitoring and education. Overall, the study highlights the importance of implementing coordinated management measures that integrate regulation, waste management, and public awareness.

1. Introduction

Invasive alien species (IAS) are organisms introduced beyond their native geographic ranges, posing significant threats to global biodiversity, ecosystem services, and socio-economic systems (Pyšek *et al*. 2020). Their impacts include the displacement of native species, alteration of habitat structures, and economic damage to agriculture, infrastructure, and public health (Colautti & MacIsaac 2004, Meyerson & Mooney 2007, CBD 2024). These species are often introduced through deliberate releases, unintentional escapes from captivity, and usage in biological control programs (Pyšek *et al*. 2020). Extensive evidence documents the ecological and economic consequences of such introductions, including biodiversity loss, disruption of ecological communities, and long-term changes in native species composition

(Thomas *et al*. 2016, Pyšek *et al*. 2020, Siddiqui *et al*. 2021, Fantle-Lepczyk *et al*. 2022). Beyond ecological harm, IAS can also adversely affect human well-being by threatening food security and acting as a vector for zoonotic diseases (Pyšek *et al*. 2020, Siddiqui *et al*. 2021).

The Common Myna (*Acridotheres tristis*) is among the world's 100 most harmful invasive alien species due to its ecological flexibility, aggressive behavior, and capacity to thrive in urban environments (Lowe *et al*. 2000). The species appears to thrive in urban and agricultural systems, resembling the ecological conditions of its native range (Holzapfel *et al*. 2006). In the Middle East, its spread has been documented across Saudi Arabia, the United Arab Emirates (UAE), Egypt, Palestine, Lebanon, Syria, and Jordan, often originating from pet trade releases and facilitated by irrigated, human-modified habitats (Rabia *et al*. 2015, Symes *et al*. 2015, Ramadan-Jaradi *et al*. 2020, Handal & Qumsiyeh 2021, Alshamlih *et al*. 2022, Aidek & Khoury 2024, Alatawi 2024).

In Jordan, reports suggested the presence of the Common Myna in the Jordan Valley since 2010 (Khoury *et al*. 2012, Khoury *et al*. 2021), followed by the first records confirmed by the Jordan Bird Records Committee (Jordan Bird Records Committee 2013). These were at the Queen Alia International Airport in Amman, Madaba, and the Jordan Valley, with signs of breeding observed near the airport and in Kafrein village (Khoury & Alshamlih 2015). A recent study showed that the species has been increasing in number and expanding into agricultural and urban areas since 2010 (Khoury *et al*. 2021). In addition, it has been identified as a potential agricultural pest in the southern Jordan Valley, where it occasionally forages on fruits without affecting the more widespread vegetable crops (Khoury 2023). However, a knowledge gap remains regarding its impacts on biodiversity, the human economy, and health in various parts of Jordan.

Studying public perceptions is essential, as citizen observations can enable the early detection of biological invasions, draw attention to ecological concerns that may be missed by formal monitoring, and inform socially acceptable management strategies. This approach aligns with the national priorities outlined in Jordan's National Biodiversity Strategy and Action Plan (NBSAP) 2025–2050, which underscores the importance of early detection, public engagement, and integrated species management. Accordingly, this study aims to: (1) document public perceptions of the distribution and abundance of the Common Myna across Jordan; (2) assess views on its ecological and socio-economic impacts; and (3) evaluate perceived drivers of its spread and levels of public support for potential control measures.

2. Materials and methods

A structured online questionnaire was developed using Google Forms. The structure and content of the questionnaire were informed by prior invasive species studies utilizing citizen science and behavioral ecology frameworks (Delaney *et al*. 2008, Bonney *et al*. 2009). Section 1 contained respondent demographics (*e.g*., gender, age, education, and governorate). In Section 2, we assessed species recognition through direct image-based identification and self-reported familiarity. In Section 3, we assessed the perception of invasiveness by asking participants to classify the species as native or non-native and to explain their reasoning, such as observed aggressive behavior toward other birds, rapid population increase, or prior knowledge from media or personal experience. In Section 4, we investigated first sightings and geographic occurrence of Common Myna. In Section 5, we assessed perceived ecological and agricultural impacts of the species through Likert-scale responses (*e.g*., effects on native birds, crop damage, noise, and disease transmission), and in Section 6 we studied attitudes toward and preferences for control strategies.

In this study, "invasiveness" refers to the ability of the Common Myna to establish, spread, and cause ecological or socio-economic harm in areas beyond its native range, as defined by international standards (Colautti & MacIsaac 2004, CBD 2024). Within the questionnaire, this concept reflects the respondents' perceived assessment of the species' impacts and status in Jordan, rather than direct ecological

measurements. The questionnaire was initially pilot-tested with 10 colleagues to ensure clarity and cultural appropriateness, and modifications were made based on their feedback.

Following the pilot phase, the finalized questionnaire was disseminated between March and April 2025 using three main online platforms: WhatsApp, LinkedIn, and Facebook. The distribution was conducted through the authors' personal and professional networks to reach a broad and diverse audience across Jordan. Participation was voluntary and anonymous. Responses were automatically recorded and stored in a Google Sheets database, which was later exported to Microsoft Excel for analysis. Duplicates were manually reviewed and excluded where necessary. A total of 201 complete and valid responses were collected across all 12 governorates. To ensure data quality and reliability, only responses from individuals who self-reported the ability to recognize the Common Myna were included in the analyses. This criterion ensured that participants were genuinely familiar with the species, thereby reducing potential bias or misinterpretation from respondents who were unable to identify it. Including only confirmed recognizers strengthened the validity of the spatial, perceptual, and impact-related findings.

No personal identifiers were collected, and

Table 1. Summary of respondents' demographics, species recognition, and perceptions of the Common Myna's (*Acridotheres tristis*) invasiveness (*n* = 201).

Category	Subcategory	*n* (%)
Gender	Male	157 (78.1%)
	Female	44 (21.9%)
Age Group	<24	11 (5.5%)
	25–34	30 (14.9%)
	35–44	61 (30.3%)
	45–54	63 (31.3%)
	≥55	36 (17.9%)
Education	High school or less	17 (8.5%)
	Diploma (A two-year post-Tawjihi technical or community college diploma)	14 (7.0%)
	Bachelor's degree	86 (42.8%)
	Postgraduate	84 (41.8%)
Governorate	Amman	104 (51.7%)
	Other governorates (combined)	97 (48.3%)
Species Recognition	Recognized Common Myna	101 (50.2%)
	Correct visual ID (among recognizers)	99 (99 of 101; 99%)
Perceived Status	Considered invasive/non-native	92 (45.8%)
	Not invasive	4 (2.0%)
	Unsure	5 (2.5%)

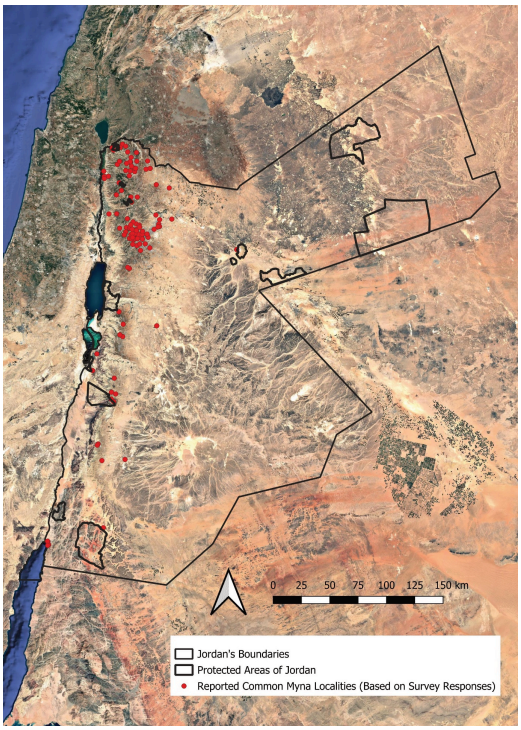

Fig. 1. Questionnaire-based observations of Common Myna (*Acridotheres tristis*) in Jordan and overlap with protected areas.

participants were informed about the purpose of the research at the beginning of the questionnaire. With consent, image or video contributions were solicited and were to be used exclusively for research purposes. The questionnaire was developed and distributed in Arabic, and an English translation is provided in the supplementary material for reference.

3. Results

The survey results presented here are based on 201 valid responses gathered across Jordan's 12 governorates. Unless otherwise indicated, all analyses presented in this section refer to the subset of respondents (n = 101; 50.2%) who recognized the Common Myna and were therefore included in the data analysis. The highest proportion of respondents was from Amman (51.7%, n = 104). Of all respondents, 50.2% (n = 101) reported recognizing the Common Myna, and 99.0% (n = 99) of these respondents correctly identified it from the provided images. Among this group, 45.8% (n = 92) of all respondents considered the species invasive and non-native to Jordan, while 2.0% (n = 4) disagreed and 2.5% (n = 5) were unsure. Demographic profiles, recognition accuracy, and perceptions of invasiveness are summarized in Table 1.

Among respondents who recalled their first observation of the Common Myna, sightings were most frequently reported between 2019 and 2024, suggesting a recent expansion. Group size at initial sightings was typically small (2–5 individuals), but larger flocks were also observed over time. The majority of respondents (n = 72) perceived an increase in local populations. A summary of sighting patterns, group sizes, and trends is presented in Table 2.

Among respondents who recognized the Common Myna (n = 101), 46.5% (n = 47) stated that they observed it regularly in their area, while 30.7% (n = 31) reported seeing it rarely. Meanwhile, 15.8% indicated they have not seen the species, and 6.9% were unsure of its presence. Additionally, 83.2% of respondents reported observing the Common Myna in regions of Jordan beyond their local area. The reported sites include initial sighting locations and areas where the species is frequently encountered, indicating an ongoing expansion of its geographic range within the country. Survey respondents reported a total of 113 distinct localities across Jordan where they have observed the Common Myna (Fig. 1).

A total of 84.2% (n = 85) of respondents reported seeing the Common Myna most frequently in residential neighborhoods. Other commonly cited habitats included agricultural lands (41.6%, n = 42), public parks (37.6%, n = 38), forests or natural areas (24.8%, n = 25), and waste collection or landfill zones (22.8%, n = 23). Industrial or artisanal zones were the least frequently mentioned, with only 9.9% of respondents reporting sightings in these environments. Regarding the time of day when the Common Myna is most frequently observed, 43.6% of participants indicated sightings occurred multiple times throughout the day. In comparison, 39.6% most often saw the species in

Table 2. Summary of Common Myna (*Acridotheres tristis*) sighting patterns, group sizes, and perceived population trends among respondents who recognized the species (*n* = 101).

Variable	Category	Respondents *n* (%)
First sighting year	2019–2024	45 (44.6%)
	2014–2018	7 (6.9%)
	2002–2013	3 (3.0%)
	Vague response ("2 years ago", etc.)	46 (45.5%)
Group size at first sighting	1 individual	17 (16.8%)
	2–5 individuals	47 (46.5%)
	6–10 individuals	15 (14.9%)
	>10 individuals	12 (11.9%)
Largest group size seen	2–5	50 (49.5%)
	6–10	27 (26.7%)
	>10	24 (23.8%)
Perceived population trend	Strong increase	44 (43.6%)
	Slight increase	28 (27.7%)
	Stable	7 (6.9%)
	Decrease	3 (3.0%)
	Not sure	19 (18.8%)

the morning (6:00–10:00 AM). 23.8% reported afternoon sightings (2:00–6:00 PM), and 15.8% noted occurrences during midday (10:00 AM–2:00 PM).

Only 2.0% (*n* = 4 of 201) of respondents reported having previously purchased a Common Myna. Among these, one person (*n* = 1) cited attraction to its appearance or vocal mimicry, and another (*n* = 1) reported buying it spontaneously after seeing it at a market. No respondents indicated that they purchased the bird for resale, gifting, experimentation, or economic reasons. Additionally, 2.0% (*n* = 4) reported having released a Common Myna into the wild. Among those who had released the bird (*n* = 4), the primary reasons cited included the belief that the bird would be freer (*n* = 1) and that the bird was noisy or disruptive at home (*n* = 3).

A total of 45.5% of survey participants (*n* = 46 out of 101 who responded to this question) reported witnessing problems or damage attributed to the Common Myna in their local areas. In comparison, 54.5% (*n* = 55) indicated no such observations. Among those who reported observing impacts (*n* = 46), the majority (*n* = 34; 73.9%) had directly witnessed these effects in their neighborhoods. Additional sources of information included social media content from within Jordan (*n* = 6; 13.0%) and verbal reports from friends or acquaintances (*n* = 4; 8.7%). Participants were further asked to assess the type and severity of the observed or perceived impacts. The most frequently cited severe impacts were related to ecological disruption. Around two-thirds of the respondents stated that the Mynas would have impacts on biodiversity and cause the displacement of native species by antagonistic behavior (Fig. 2). Respondents also expressed concern about potential disease transmission, which they associated with the Common Myna's observed scavenging behavior in waste sites. While no specific disease incidents were reported, 18 participants rated this risk as low and 14 as moderate.

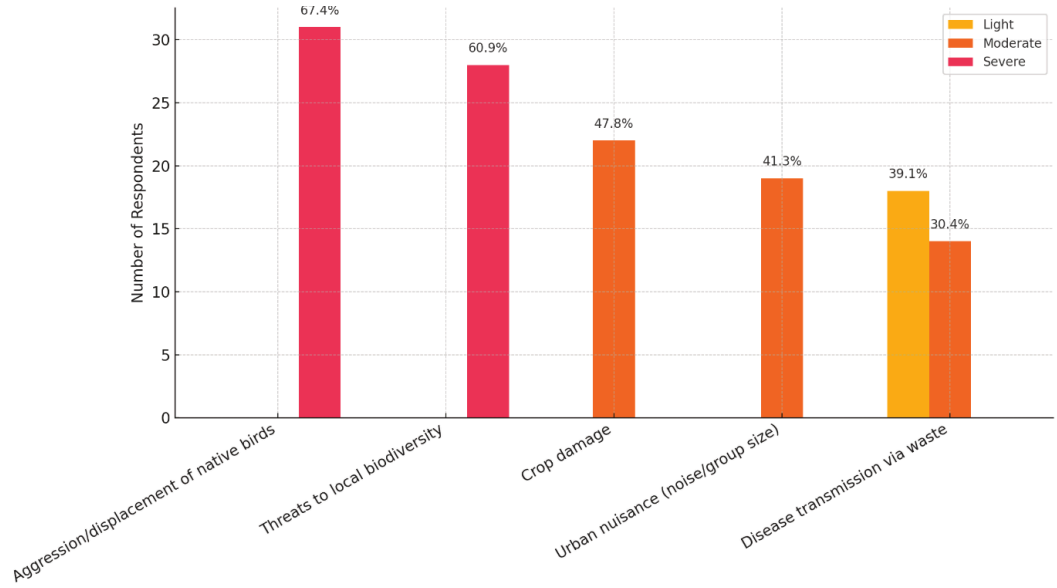

Fig. 2. Perceived ecological and anthropogenic impacts of the Common Myna (*Acridotheres tristis*) in Jordan by type and severity.

Findings indicate that the species' high adaptability to various environmental conditions was the most widely agreed-upon explanation for its successful establishment and spread in Jordan, with 81.0% (n = 163) of respondents highlighting its ability to thrive in urban, peri-urban, and human-modified landscapes. In addition, 69 participants (34.3%) emphasized the Myna's behavioral flexibility as a key trait enabling successful establishment across diverse habitats. The most agreed-upon factor was the availability of human-derived food resources, with 147 respondents (73.1%) linking the species' success to abundant anthropogenic food sources near human settlements. This was followed by 143 respondents (71.2%) who cited urban expansion and associated land-use changes, such as the growth of residential areas, public parks, and unmanaged waste zones, as key drivers of establishment and spread. The availability of human-derived food resources, particularly organic waste, was the second most agreed-upon factor, with 73.1% of participants linking the species' success to abundant anthropogenic food sources near human settlements.

Institutional and legislative shortcomings in invasive species governance also emerged as significant concerns, with 145 respondents (72.2%) highlighting the weak enforcement of regulations, minimal oversight of the pet trade, and insufficient monitoring of bird ownership and releases as contributing factors to the spread of the species. Environmental drivers were acknowledged to a slightly lesser degree, with 133 respondents (65.9%) emphasizing the lack of regulatory mechanisms governing the release of individual birds into the wild. Some participants (n = 21) also mentioned climate variability, including rising temperatures and decreased rainfall, as indirect facilitators of Myna spread.

Recreational activity and tourism were noted by 110 respondents (54.7%), but with lower agreement compared to drivers such as food waste and urban expansion. Similarly, the absence of natural predators was mentioned by 87 respondents (43.3%), although responses showed greater variability in perceived importance, suggesting less certainty about this factor relative to more strongly supported drivers, such as regulatory gaps (72.2%) and food availability (73.1%).

4. Discussion

Citizen science significantly enhances invasive species research by broadening monitoring efforts, involving the public in data collection, and supporting conservation initiatives that inform management strategies and increase public awareness (Cooper *et al*. 2007, Delaney *et al*. 2008, Bonney *et al*. 2009). Our survey provided additional and recent occurrence data for the Common Myna in Jordan, as well as information about the public's awareness of this invasive species. Moreover, we assume it fostered public awareness and likely had an educational function. The high rate of accurate identification by respondents indicates a strong level of public recognition, which aligns with previous studies showing the species' widespread presence in urbanized and agricultural areas in Jordan (Khoury *et al*. 2021) and Egypt (Rabia *et al*. 2015).

There was overwhelming support among respondents for implementing control programs to manage Jordan's Common Myna population. Approximately 90.1% of participants supported such programs, only 5.9% opposed the idea, and 4.0% indicated indifference. This strong endorsement reflects a growing public awareness of the ecological and social impacts of invasive species, aligning with findings from citizen-based studies elsewhere (*e.g*., Grarock *et al*. 2014, Cohen *et al*. 2019). The preference for evidence-based and humane interventions underscores the growing societal expectation that invasive species management should strike a balance between ecological effectiveness and ethical considerations (Feare *et al*. 2022). Comparable attitudes have been reported in Australia and South Africa, where the control measures for the Common Myna are more widely accepted when coupled with educational outreach and protection of native species (Peacock *et al*. 2007). These findings suggest that participatory approaches integrating public engagement, research, and non-lethal management can enhance long-term program acceptance and success. For Jordan, this highlights the opportunity to design culturally sensitive and community-supported management frameworks that combine scientific assessments, public awareness, and waste management to curb further expansion of the species while reinforcing conservation ethics.

The spatial distribution of the Common Myna in Jordan is concentrated in the northwestern and central-western regions, particularly in urban centers such as Amman, Irbid, and Zarqa, where human density and food availability support establishment (Khoury *et al*. 2021). While arid zones with low human activity, such as Jordan's eastern deserts, remain largely uncolonized, there has been notable expansion along transportation corridors in central desert areas, enabling the species to reach villages and towns, as predicted by previously prepared distribution models (Khoury *et al*. 2021). The respondents did report the colonization of two new areas after 2020 (Ma'an and Tafila), which can be used to validate and confirm the model for predicted distribution. A sharp increase in observations by the respondents between 2019 and 2024 suggests a recent surge in urban populations of this species, echoing trends observed in neighboring countries such as Lebanon and Syria (Ramadan-Jaradi *et al*. 2020). The earliest record in Jordan, dating back to around 2010, aligns with regional colonization timelines (Holzapfel *et al*. 2006, Khoury *et al*. 2021). Of particular concern is the Common Myna's presence near protected areas such as Dibeen, Ajloun, Fifa, Mujib, and Dana, where it may pose risks to the ecosystems and native avifauna through competition and habitat disturbance (Feare & Craig 1998).

Group size trends and perceived population in sightings increases highlight the social nature and opportunistic foraging strategy of the Common Myna. While the high frequency of sightings in synanthropic environments such as residential, agricultural, and parkland areas reflects the species' known preference for urban and edge habitats (Peacock *et al*. 2007), it is important to acknowledge that these patterns may also be shaped by observer bias, as citizen scientists are more likely to report from areas they frequently visit or reside in. The respondent's identification of behavioral flexibility, urban expansion, and food waste as key drivers aligns with invasion models and parallel findings from Australia, Jordan, and other locations (Grarock *et al*. 2014, Cohen *et al*. 2019, Khoury *et al*. 2021).

Nearly 74% of respondents expressed

concerns about native bird displacement, and many claimed to have had direct observations of interactions with native species. Such interactions are not unexpected and may mirror global findings on Myna's competitive exclusion for nesting and food (Lowe *et al*. 2000, Peacock *et al*. 2007, Cohen *et al*. 2019). Common Mynas have been suggested as a cause for declines in native species in Lebanon (Ramadan-Jaradi *et al*. 2020) and reduced breeding success in Egypt's Sinai (Rabia *et al*. 2015). While impacts on human health and economy, such as crop loss, noise, and disease risk were considered moderate in our survey, they align with conflicts reported in Australia and South Africa (Grarock *et al*. 2014, Cohen *et al*. 2019). The urban sprawl and inadequate waste management which have facilitated the successful colonization of the Common Myna in Jordan is potentially increasing the risk of disease transmission and associated public health concerns.

Our study revealed strong support (90.1%) for controlling the Common Myna, reflecting widespread concern about its ecological and social impacts. Respondents favored non-lethal strategies such as education, nest removal, and humane trapping, underscoring the need for socially acceptable approaches (Grarock *et al*. 2014, Feare *et al.* 2022). Additionally, the survey functioned as an awareness-raising tool, echoing findings from other regional initiatives that leveraged citizen engagement to increase the understanding of invasive species (Ramadan-Jaradi *et al*. 2020, Handal *et al*. 2023).

Previous market surveys found no evidence of Myna trade in Amman (Eid *et al*. 2011), which aligns with our results, where only 2% of respondents reported prior ownership. Additionally, analyses of hunting-related social media did not record the species, indicating it is neither targeted for consumption nor trade (Eid & Handal 2018). These findings confirm that intentional introduction through local trade is currently minimal. However, there was strong support among respondents for strengthening the legislation and enforcement mechanisms to regulate the trade and possession of the species in local markets, reflecting growing public awareness of its ecological impact. The continued spread of the Common Myna in Jordan appears to be driven primarily by its ecological adaptability and human-mediated factors, including urban expansion, weak enforcement of pet ownership regulations, and the widespread availability of anthropogenic food waste. As such, the Myna's invasion represents not just a biological issue but a complex socio-ecological challenge, reinforcing the urgency for multidisciplinary management approaches that integrate public engagement, legal frameworks, and urban planning (Holzapfel *et al*. 2006).

Although some respondents reported direct observations of Common Myna impacts, others likely reflected general beliefs or secondhand information. We therefore interpret these perceptions with caution, viewing them as indicative of public sentiment rather than definitive ecological evidence. This underscores the role of citizen science as a complementary tool for awareness and early detection. Furthermore, because most respondents reside in or frequent urban and peri-urban environments, reported sightings may be influenced by sampling bias. The observed concentration of the species in synanthropic areas may partly reflect higher human presence and observation effort in those landscapes.

This study contributes to the growing body of literature on public perceptions of invasive alien species by using the Common Myna in Jordan as a case study. By integrating spatial sighting data with perception-based responses, the research underscores both the ecological visibility and social salience of the species. Findings reveal a rising public awareness of the Myna's spread and impacts, alongside mixed levels of support for various management actions. While not a substitute for formal ecological monitoring, these insights highlight the value of citizen science, particularly in data-limited regions such as Jordan. Moreover, the study provides an important entry point for broader public engagement and sets the stage for future interdisciplinary research in invasive species management.

In light of these findings, the upcoming release of the Ministry of Environment's Black Book of Invasive Species, alongside Jordan's National Biodiversity Strategy and Action Plan (NBSAP) 2025–2030, marks a timely and

strategic advancement. As a key national policy instrument, the Black Book is expected to guide efforts to monitor, prevent, control, and mitigate threats from invasive species. This study contributes to the existing data set, directly supporting its implementation by offering insights to inform action planning and national response measures. It is essential to note, however, that the study employed a combination of convenience and snowball sampling strategies, utilizing the researchers' networks and online platforms for dissemination. While this approach successfully captured a geographically and demographically diverse sample, the results reflect the perceptions of participating respondents and should not be generalized to the broader Jordanian population. This limitation, a standard in citizen science methods that rely on self-selection, underscores the need for future research to adopt more representative sampling frameworks.

Medborgarvetenskapliga uppfattningar om utbredning och effekter av brunmajnan (*Acridotheres tristis*) i Jordanien

Brunmajnan (*Acridotheres tristis*) är en globalt erkänd invasiv främmande art med dokumenterade ekologiska och sociala effekter. I denna studie använde vi ett medborgarvetenskapligt tillvägagångssätt för att undersöka utbredningen samt de upplevda ekologiska och ekonomiska effekterna av den vanliga majnan i Jordanien. En webbaserad enkät gav 201 giltiga svar från samtliga tolv guvernement, varav endast 50,2 % av respondenterna, som kände igen arten, inkluderades i den efterföljande dataanalysen.

Rapporter från 113 lokaler visade, att arten är koncentrerad till urbaniserade områden i nordvästra Jordanien. En ökning av observationer sedan 2019 tyder på populationsökning och fortsatt spridning över människopåverkade landskap. Ökad förekomst nära skyddade områden och jordbruksmarker väcker ekologiska farhågor. Respondenterna identifierade konkurrens med inhemska fåglar som den främsta påverkan, medan effekter på grödor och människors hälsa (t.ex. buller) uppfattades som mindre. Stadsutbredning och livsmedelsavfall ansågs vara de viktigaste drivkrafterna bakom spridningen. Utöver datainsamlingen fungerade enkäten även som ett verktyg för medvetandegörande och visade på det dubbla värdet av medborgarvetenskap – både för övervakning och utbildning. Sammanfattningsvis betonar studien vikten av att genomföra samordnade förvaltningsåtgärder som integrerar reglering, avfallshantering och allmän medvetenhet.

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Online supplementary material

Supplementary material available in the online version of the article includes the questionnaire in Arabic and English.