

RESEARCH ARTICLE

Enabling endangered species conservation on private land: A case study of the ocelot in Texas

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Abstract

The ocelot (*Leopardus pardalis*) is a wild cat distributed from the southern U.S. to northern South America. In the U.S., ocelots are classified as endangered, and breeding ocelot populations are only found in Texas—a state composed of mostly private lands. Ocelot recovery in the U.S. depends on successful conservation actions on private lands. Unfortunately, throughout the history of the Endangered Species Act (ESA), listed species conservation on private lands has often been plagued by poor landowner participation due to fear of ESA regulations impacting land use. Here, we examine an effort to accelerate the recovery of the ocelot by reintroducing the endangered cat to private lands within its historic range in Texas. The case study of the planned ocelot reintroduction on private lands in Texas, combined with review of literature on ESA implementation on private lands, has illustrated key factors for enabling private landowner engagement in threatened and endangered species recovery. Such factors include providing financial incentives and regulatory assurances to landowners, connecting to landowners' intangible motivations to conserve wildlife, meeting the practical needs of conservation project implementation while still giving landowners autonomy over the effort, maximizing landowner comfort with a conservation program, and allowing participation to be nonpermanent and adaptable. Over the next 50 years of ESA implementation, these will be important considerations for accelerating species sustainment and recovery efforts on private lands.

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KEYWORDS

Endangered Species Act, *Leopardus pardalis*, ocelot, private lands, reintroduction, Safe Harbor Agreement, Texas

In the United States, 50 years of conservation under the Endangered Species Act (ESA) of 1973 have seen the protection of hundreds of threatened and endangered species and their habitats. Many cite the law as a success, as the ESA has prevented the extinction of 99% of listed species (Greenwald et al. 2019) and improved the status of many species (Schwartz 2008). However, even with measurable successes and 50 years as a primary regulatory framework for conservation of fish, wildlife, and plants in the United States, questions and controversies surround the ESA's performance. For example, only 54 species, about 3% of the over 1,600 native species ever listed, have been recovered and delisted from the ESA (U.S. Fish and Wildlife Service 2021). Improving efforts for listed species on private lands is of particular interest for improving recovery rates (Bean 2009), given that existing protected public lands are not sufficient to conserve all of the United States' biodiversity (Jenkins et al. 2015).

The majority of land in the eastern U.S. is privately owned, with 17 states across the Midwest, Northeast, and Southeast having more than 90% private land ownership (Texas A&M Natural Resources Institute 2021). At least 80% of ESA-listed species can be found on private lands (Schwartz 2008), and one-third exist exclusively on privately owned lands (Evans et al. 2016). As such, it is imperative that wildlife conservationists and land managers pursue listed species sustainment and recovery activities on private lands (Clancy et al. 2020). Habitat loss is one of the principal drivers of species declines (Maxwell et al. 2016, Caro et al. 2022), and the highest rates of habitat loss for imperiled species in the U.S. occur on private lands (Eichenwald et al. 2020). Conservation efforts on private lands are necessary to prevent habitat loss and imperiled species extirpation, and to improve recovery efforts for ESA-listed species at a landscape scale (Sorice et al. 2013, Epanchin-Niell and Bound 2020).

Implementing listed species recovery activities on private lands has been challenging over the past 50 years. In part, this can be attributed to private landowner concerns about ESA regulation on the take of fish and wildlife listed as federally threatened or endangered under the ESA. Take of listed animals is prohibited without a federal permit, and take prohibitions are subject to criminal and/or civil penalties. As defined in the ESA, take of a species equates to an attempt to directly harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect it. Harm to a listed species may include modifications of a species' habitat, such as during land use, that indirectly result in impacts on a species' essential behaviors (foraging or sheltering) and, ultimately, its injury or death (U. S. Fish and Wildlife Service 2018). Such unintentional or incidental take of a species due to a landowner's otherwise legal modification of species habitat can be federally permitted. Yet, for landowners, the federal prohibition on harm to a listed species' habitat without an incidental take permit can easily be viewed as a federal restriction on private land use. Such restrictions could ultimately threaten landowners' authority over their land, and the economic viability of their operations (Brown Jr. and Shogren 1998, Lueck and Michael 2003, Hansen et al. 2018).

Regulatory concerns about violating the ESA through impacts to listed species' habitat have sometimes led individual landowners to avoid listed species surveys on their lands so that the U.S. Fish and Wildlife Service (USFWS) can have no evidence of species presence there and thus no ability to enforce the ESA (Brown Jr. and Shogren 1998, Polasky and Doremus 1998). Landowners have even proactively destroyed listed species habitat on their properties to discourage species occupancy (Lueck and Michael 2003, List et al. 2006). Others show reduced interest in conserving a species once it becomes listed due to concerns about ESA restrictions on management of their land (Knapp et al. 2015). As such, the ESA may actually be disincentivizing, rather than incentivizing, species recovery efforts on private lands.

In response to the challenges with conservation on private lands, a variety of innovations have been developed to address landowners' concerns about ESA regulations while providing incentives and opportunities for conservation on private property. One mechanism for private land conservation is the conservation easement, which has historically proven to be the most popular tool to incentivize landowners to conserve habitat (Cortés Capona et al. 2019). Other approaches to reward conservation work, such as conservation banking, have also shown

promise in recent years (Poudel et al. 2019). Tools developed specifically to remove ESA disincentives for listed species conservation on private lands include Habitat Conservation Plans (Langpap and Kerkvliet 2012), Safe Harbor Agreements (Wilcove and Lee 2004), and Candidate Conservation Agreements with Assurances (Schuler et al. 2020). Each program, the latter 2 of which have been combined into 1 program called Conservation Benefit Agreements, provides both incidental take coverage to landowners who participate in listed species conservation efforts and assurances of no regulatory surprises related to new land management requirements for the listed species. Incidental take coverage assures landowners that, in parallel to their other conservation efforts, they may incidentally harm a species due to habitat modifications occurring due to land use.

Texas provides ample opportunity to study conservation of listed species on private lands, as over 95% of the land base is privately owned (Leslie Jr. 2016) and more than 100 ESA-listed plants and animals are present (U.S. Fish and Wildlife Service 2015). Here, we describe an effort to accelerate the recovery of the endangered ocelot (*Leopardus pardalis*) on private lands in Texas. In this case study, a private landowner led a multi-organization effort to create plans for ocelot reintroduction on private lands, and the landowner itself has committed to implementing ocelot reintroduction plans on the ground. Our objective was to analyze the ocelot case study, along with published literature, to identify broad factors relevant to private landowner engagement in threatened and endangered species recovery programs that may aid in conservation efforts on private lands over the ESA's next 50 years.

OCELOT REINTRODUCTION ON PRIVATE LANDS IN TEXAS AS A RECOVERY TOOL

The ocelot is a medium-sized wild cat species that has been listed as federally endangered under the ESA since 1982 (U.S. Fish and Wildlife Service 2016). It is one of many ESA-listed species that have been saved from extinction but have not yet recovered from imperiled status (Greenwald et al. 2019). Ocelots are currently found throughout Central America and the northern half of South America, and they historically occupied parts of Texas, Arkansas, Louisiana, and Arizona (U.S. Fish and Wildlife Service 2016). However, habitat loss and overexploitation in the 1900s caused ocelot populations in the U.S. to decline, and today only 2 known breeding ocelot populations remain in the nation (U.S. Fish and Wildlife Service 2016). Both extant U.S. ocelot populations are found in South Texas along the Gulf of Mexico. Ocelots are estimated to number up to 100 individuals in Texas (Lombardi et al. 2021), but the exact geographic extent of ocelot populations in Texas is unknown due to lack of information about ocelot abundance or distribution on private lands where they occur (U.S. Fish and Wildlife Service 2016). Low genetic diversity due to historic population bottleneck and isolation from ocelot population in Mexico (Janečka et al. 2011) plus high anthropogenic mortality due to vehicle collisions (Blackburn et al. 2021) threaten the small ocelot populations in Texas. Further, ocelots in Texas may be vulnerable to extirpation due to a single catastrophic event, such as a wildfire or hurricane, which could impact the entire range of occupied ocelot habitat in Texas.

Reintroduction of an additional population of ocelots to parts of their historic but now unoccupied range in Texas is among the necessary actions for ocelots' recovery from the ESA (U.S. Fish and Wildlife Service 2016). Given land ownership patterns in Texas, this reintroduction must occur on private lands. While some Texas landowners may be interested in providing their lands for the reintroduction of the ocelot, they may also have concerns that establishing a local ocelot population will expose them to new ESA regulations that may threaten their livelihoods. As such, landowners need assurances that if they contribute to ocelot reintroduction, their land uses can be maintained without increased exposure to federal ESA regulation.

In 2021, the East Foundation organized a collaboration among itself, USFWS, the Texas Parks and Wildlife Department (TPWD), and various universities, zoological institutions, and conservation organizations to develop plans for reintroducing an additional population of ocelots in Texas (RecoverTexasOcelots.org). East Foundation is a South Texas private landowner with a mission to promote the advancement of land stewardship. East Foundation owns 6 ranches across South Texas, including the El Sauz Ranch (approximately 11,000 ha) that is occupied by wild

ocelots (Lombardi et al. 2022), and recognizes that ocelot reintroduction to historic habitat is necessary for the species' recovery.

The first objective in the reintroduction planning collaboration was to identify suitable habitat within ocelots' historic but unoccupied range in Texas that could be utilized for reintroduction. Partners identified multiple suitable habitat patches that could serve as reintroduction sites (Martinez et al. 2024) and then selected a single site to use for the initial ocelot reintroduction. The selected reintroduction site (36,300 ha) is within the ocelot's historic range and is approximately 161 km west of existing ocelot populations in Texas. It occurs almost completely on remote, privately owned lands—including part of another East Foundation property, the San Antonio Viejo Ranch—that are used for cattle ranching and wildlife management (Martinez et al. 2024).

LEGAL APPROACHES TO OCELOT REINTRODUCTION ON PRIVATE LANDS IN TEXAS

In addition to conducting outreach to garner landowner support for ocelot reintroduction to occur at the selected reintroduction site, partners also recognized the need to create a mechanism to address private landowners' regulatory concerns about reintroducing an endangered species to a site composed of private working lands. Partners identified the ESA 10(j) rule and the Safe Harbor Agreement (SHA) as 2 options that could be used as mechanisms for reintroducing endangered ocelots to private lands and addressing landowner concerns about the threat of new federal regulation on land use based on the ESA's prohibition on harm to listed species due to habitat modification. A federal 10(j) rule, if approved by USFWS following a public comment period and thorough federal review, allows the USFWS to reintroduce an experimental population of a listed species into a defined 10(j) area that can cover both public and private lands. In a 10(j) rule, USFWS may write incidental take and/or deliberate take exemptions for the reintroduced species across the entire 10(j) area. Exemptions on incidental take could assure all private landowners in the 10(j) area that they can continue with their ongoing land management practices, even after a protected species is reintroduced and may be impacted by land use (Cribb 1998).

Alternatively, in a SHA with USFWS, landowners agree to voluntarily perform conservation actions on their properties, such as habitat management or species reintroductions, which will benefit the recovery of a listed species. Landowners participating in a SHA can be allowed some incidental take of the listed species so long as the benefits to the species outweigh the impacts of any allowable incidental take and maintain the baseline number of species or amount of habitat present when the agreement was initiated. Along with incidental take exemptions and opportunities to return to baseline with no penalties, USFWS also assures landowners participating in SHAs that no additional land/resource use restrictions nor conservation requirements, outside of those identified in the SHA, will be applied to their lands. Such assurances can also be extended to a participating landowner's direct neighbors and other proximate properties. Landowners are free to leave an SHA at any time during the agreement's term and can discontinue the conservation practices with no penalties, even if that leads the species or habitat to decline back to baseline conditions.

Partners in the ocelot reintroduction study agreed that both the 10(j) rule and the SHA were viable options for providing regulatory assurances to private landowners who offer their lands for the reintroduction. Partners ultimately determined that a SHA was the most appropriate option for initial ocelot reintroduction efforts. Justifications included the process of developing the mechanism, the anticipated scale of the reintroduction, and previous landowner experience. First, partners believed that because it will be the first attempt to reintroduce ocelots to Texas, there will likely be a need for adaptive management. Since the SHA does not need to proceed through the federal rule-making process to be revised, as a 10(j) rule would, adaptive management is likely more straightforward in a SHA. Second, the East Foundation owns a ranch containing >30% of the identified suitable habitat at the selected ocelot reintroduction site (Martinez et al. 2024), and it estimated that <10 other landowners owned the remaining habitat. Partners believed it was reasonable for East Foundation to initiate a programmatic SHA and

engage the small number of other landowners in the agreement via a targeted and relational approach, while a 10(j) rule may be better suited for a larger area where there are too many landowners to coordinate with individually. Third, the East Foundation, as the leader of ocelot reintroduction activities and private landowner coordination, had previous experience participating in a similar programmatic SHA for the northern aplomado falcon (*Falco femoralis*) in South Texas. East Foundation believed that its knowledge of the SHA process and its positive experience with the program could help demystify and clarify the SHA to other landowners within potential ocelot reintroduction habitat and encourage them to participate in an SHA for ocelot reintroduction.

DEVELOPMENT OF A PROGRAMMATIC SAFE HARBOR AGREEMENT FOR OCELOT REINTRODUCTION

East Foundation, as the majority owner of land within the selected site for ocelot reintroduction, elected to initiate a programmatic Safe Harbor Agreement for ocelot reintroduction and to apply for an associated enhancement of survival permit in order to establish regulatory assurances for its working ranchlands and nearby lands within the ocelot reintroduction habitat. Several entities, including the Texas A&M Natural Resources Institute, Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville, TPWD, and USFWS provided support to East Foundation in preparing SHA and permit application materials.

The SHA included a variety of sections designed to create benefits for both ocelot conservation and private landowners. First, East Foundation explained in the SHA that alone, ocelot reintroduction to an area with a baseline of zero ocelots would benefit the ocelot's recovery by increasing the number of wild ocelots in Texas and expanding the species' occupied range there. While other habitat protection or research activities could also be beneficial, the East Foundation has discretion under the SHA on if and how to implement other measures to support the reintroduced ocelot population. Additional partners that could assist with field activities and monitoring were designated by East Foundation in the SHA. The SHA also described the available habitat in the reintroduction site and the ongoing land uses there that would be protected from additional ESA regulations for ocelots by the SHA and the associated permit. The programmatic nature of the SHA allows other nearby landowners to participate in the SHA and receive regulatory assurances by obtaining from East Foundation certificates of inclusion to East Foundation's permit. East Foundation and USFWS also agreed to provide assurances of no new land-use restrictions to nearby landowners not participating in the SHA should reintroduced ocelots disperse to their lands. A data retention process was also established in the SHA to protect landowner confidentiality regarding their participation in the agreement and the presence of ocelots on their lands. Finally, the agreement length was established at 30 years, with the opportunity to terminate early or extend the agreement. In March 2024, the agreement was signed by both East Foundation and USFWS, and the USFWS issued East Foundation an enhancement of survival permit for ocelot reintroduction under the SHA.

FACTORS ENABLING PRIVATE LANDOWNER PARTICIPATION IN LISTED SPECIES CONSERVATION

In the process of identifying the SHA as the ideal mechanism for ocelot reintroduction and subsequently developing a Programmatic SHA for ocelot reintroduction on East Foundation ranchlands and nearby private lands, factors enabling private landowner engagement in threatened and endangered species conservation efforts emerged. We identified 10 considerations important for engaging private landowners in the conservation of listed species over the next 50 years of the ESA. We suggest that these considerations can aid in other conservation actions aimed at threatened and endangered species on private lands, and they can have wide implications for conservation efforts far beyond ocelot conservation or the state of Texas.

1. Regulatory assurances and clarity. A primary barrier to participation in listed species conservation on private lands is the threat of ESA regulation upon acknowledgement of the presence of a listed species on private lands (Wilcove and Lee 2004, Langpap 2006, Sorice et al. 2013, Epanchin-Niell and Bound 2020). Ocelot reintroduction partners recognized that regulatory assurances for private landowners at the reintroduction site are critical because they assure landowners of the freedom to continue to operate even when listed species become present on their lands. In developing the SHA, partners clearly established that private landowners contributing to ocelot reintroduction, and their nonparticipating neighbors whose lands are within the potential dispersal range of an ocelot and thus could be colonized by reintroduced individuals, would be assured of no additional land use restrictions or conservation requirements related to reintroduced ocelots that could impact the landowners' abilities to continue working their lands.
2. Landowner autonomy. Landowners need ESA regulatory assurances to maintain their freedom to operate, and they may also want the autonomy to design and implement conservation activities taking place on their properties (Larson and Lach 2010, Sorice et al. 2013). Landowner autonomy over a conservation activity may be especially important for landowners with scientific and/or land management expertise, such as East Foundation, which is an Internal Revenue Service-designated Agricultural Research Organization with an experienced professional staff of wildlife biologists and land managers. In the SHA for ocelot reintroduction, the East Foundation requested the discretion to implement habitat management and protection practices, for example, supported by scientific research. Meanwhile, many landowners in Texas are either first-time or absentee owners (Lund et al. 2017), suggesting that landowner experience and expertise must be considered when determining if it is most appropriate for landowners to have autonomy over conservation activities or if the species is best served by co-management of conservation activities with USFWS, a state wildlife agency, or another conservation partner providing technical guidance.
3. Financial incentives. Removal of the threat of regulation may not be enough to encourage private land conservation. Financial incentives may also be needed not just to motivate landowners and reward them for conserving species, but also to assist with the real costs of conservation. Financial incentives, such as tax credits from conservation easements, direct payments from Farm Bill programs, or cost sharing from state wildlife agency grants can help landowners make up for lost profits when land is taken out of production, for example, and can help pay for conservation activities like prescribed burns or species surveys (Wilcove and Lee 2004, Hansen et al. 2018).
4. Land stewardship ethic. Private landowners across the United States are often committed to performing conservation activities and acting as good stewards of their lands and the species present there, even if it means taking on personal costs (Larson and Lach 2010, Hansen et al. 2018). Recovery planners can capitalize on conservation sentiments to encourage species conservation even where financial incentives are not available or are not needed by the landowner. Additionally, landowners' stewardship ethics may inspire them to champion private lands conservation efforts and advocate for participation from other landowners who may prefer to hear from a peer rather than an agency or non-profit organization. Finally, species charisma is clearly a factor that impacts ESA recovery efforts (Bellon 2019) and has benefitted the ocelot. It may be easier to channel stewardship ethics into the conservation of a charismatic species like the ocelot that landowners already have knowledge of or interest in. Species like the ocelot can serve as umbrella species for habitat conservation that benefits other species (Branton and Richardson 2011).
5. Previous participation and peer-to-peer interactions. When it elected to develop a SHA for ocelot reintroduction, East Foundation already had over 5 years of experience participating in another SHA for species reintroductions. East Foundation's previous engagement shows that a landowner who has previous positive experience with an ESA conservation program may be primed to participate in another similar program. Further, it is helpful to engage experienced landowners as program champions who can encourage other landowners to participate.
6. Technical assistance. Landowners may need more than just regulatory assurances, funds, experience, and goodwill to be encouraged to implement listed species conservation efforts. Technical guidance can also be important for landowners who do not have the expertise or the capacity to conduct conservation activities

- (Wilcove and Lee 2004). In the SHA for ocelot reintroduction, it was important to establish USFWS, TPWD, and research universities as cooperating partners for actual in-the-field management and monitoring of ocelot reintroduction. Though landowners may want to maintain ultimate responsibility for a conservation program on their property, the case study showed that assistance from qualified partners is also important.
7. Adaptive management. Those who are managing their lands for production and economic viability recognize that circumstances change, and adaptability is important. Yet, conservation agreements for private lands can sometimes occur through one-time permitting where conservation practices are never revisited and revised (Doremus 2001). Unchanging permits or plans are likely insufficient for supporting species recovery when circumstances change. The ability to use adaptive management was a large consideration in the selection of a SHA over an ESA 10(j) rule for ocelot reintroduction. While the revision of federal rules can be a lengthy process, private landowner agreements like the SHA can be updated as necessary via a more streamlined and efficient process. Ease of revision is an important consideration for landowners who could see changed circumstances in either their conservation programs or their own livelihoods.
 8. Flexibility. Conservation easements are the most commonly used conservation tool in the United States (Cortés Capona et al. 2019), but their restrictiveness and permanence can be daunting to some landowners (Ando and Chen 2011). An SHA, meanwhile, is not permanent; the landowner may choose the length of the agreement and can leave the agreement, if necessary, before its expiration upon proper notification to USFWS. Nonpermanent programs such as SHAs assure private landowners that they have the flexibility to change management even if personal situations—which may impact their ability to conduct conservation—change.
 9. Landowner confidentiality. The ESA is a highly litigated law, and landowners may be concerned that publicizing the presence of listed species on their lands will lead to citizen-led lawsuits targeting their private actions, or other undesired public attention (Koch 2002, Nathanson et al. 2015). While some landowners may want to publicize their conservation efforts for reputational rewards (Langpap et al. 2018), others may prefer confidentiality to minimize the risk of litigation. By not publicly disclosing property-specific information related to species locations or conservation program participation, and by protecting data from Freedom of Information Act (FOIA) requests, conservation program managers can support landowner confidentiality. One way to protect data is to require non-federal partners, who are not subject to FOIA, to hold property-specific species location data. Landowners must still understand that failure to comply with their conservation agreement could trigger enforcement actions that impact confidentiality.
 10. Ease of use and participation. The 10(j) rule may be attractive to landowners because there is no participation or relationship with USFWS required to obtain regulatory assurances, as in an SHA where an agreement with USFWS is necessary. Yet, we found in our case study that the process of developing a 10(j) rule and completing the rule-making process would be challenging for USFWS and collaborating partners. The SHA, in contrast, is likely faster and simpler to create, though it does require landowner relationships with USFWS to develop the agreement and monitor its implementation. Such relationships could prove beneficial for spurring future collaborative conservation efforts. Meanwhile, a single landowner (or other coordinating partner, such as a state agency or conservation organization) initiating a programmatic SHA can reduce procedural steps for other participants—who can sign up to participate but do not have to design the agreement—and the programmatic administrator can interface between participating landowners and USFWS to minimize additional landowners' necessary level of interaction with the federal government, as necessary.

CONCLUSION

Aldo Leopold once wrote that “Conservation will ultimately boil down to rewarding the private landowner who conserves the public interest” (Leopold 1934: 544). The financial incentives that Leopold referred to and, with the creation of the ESA, regulatory assurances, have long been recognized as landowners' 2 top needs for engaging in

conservation programs for ESA-listed species on private lands. However, landowners' considerations when deciding whether to participate in listed species conservation programs and what their participation looks like extend well beyond just financial incentives and obtaining regulatory certainty. Such considerations explain why the East Foundation, a private landowner in Texas, and others will consider making considerable efforts to recover the endangered ocelot on private lands.

While the ESA sometimes prompts landowners to conceal the presence of listed species on their lands or even to manage habitat to prevent listed species occupancy, some landowners aspire to support endangered species on their lands. A review of literature and the case study of ocelot reintroduction planning in Texas presented the opportunity to explore the variety of factors that may impact engagement in listed species conservation programs on private lands. The list of factors include financial incentives, regulatory assurances, intangible motivations (e.g., land stewardship ethic), practical considerations (e.g., the need for technical and financial assistance), program design specifications (e.g., landowner autonomy, length of a program, flexibility to change efforts, and use of adaptive management), and landowners' comfort with the programs (e.g., ease of use, previous experience, and confidentiality).

It must be recognized that each landowner may have different values and concerns based on their own individual situation, and there is likely no one-size-fits-all solution for accelerating listed species conservation efforts on private lands (Sorice et al. 2011). Rather, individual landowners may each have their own individual needs and motivations for listed species conservation, and selection of any particular private-lands conservation tool must be context-specific (Bennett et al. 2018). Landowners themselves likely need the ability to select or design a conservation program that will work for them based on their own levels of financial commitment, need for flexibility and technical assistance, and more. Ocelot reintroduction efforts being led by the East Foundation, a private landowner, in cooperation with agency, university, and zoological institution partners, provide a model for private landowners to drive the development of programs that benefit both species of concern and landowners. Landowner-driven innovations may ultimately serve to guide and direct future ESA efforts on private lands in the next 50 years.

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The authors declare no conflicts of interest.

ETHICS STATEMENT

The authors declare no conflicts of interest. No animals were handled for this study.

DATA AVAILABILITY STATEMENT

No data were collected or analyzed for this research.

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