# At the Interface between Livestock and Predators: Reducing the Risk of Livestock-Predator Interactions among Youth Animal Owners

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**ABSTRACT**: Predator issues related to interactions with livestock and poultry represent a state, national, and international issue. Predators are important for healthy ecosystems; however, with increased interactions between predators and agricultural animals there is also an increased likelihood of predator depredation. The 4-H Youth Development Program is a national nonformal youth education program. Annually, over 1.5 million youth participate in 4-H Animal Science projects, mainly agricultural animals. 4-H youth who raise agricultural animals face issues of predator-livestock interactions. A 4-H curriculum was developed to help youth learn about predator-livestock interactions and strategies to mitigate these issues through improved animal husbandry. Pilot research on the use of the curriculum revealed improved knowledge among participating youth, as well as the application of mitigation strategies to youths' own practice and outreach to their communities through a service-learning project.

**KEY WORDS:** 4-H, curriculum, depredation, livestock, human-wildlife conflict, predators, science literacy, youth science

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## BACKGROUND

### The Issue

Predator issues as they relate to interactions with livestock and poultry represent a state, national, and international concern. In particular, the conflict between predators and animal agriculture, where agricultural animals serve as a source of prey, leads to financial losses for growers (Scasta et al. 2017). In 2010, it was estimated that 180,000 sheep and 219,000 cattle were lost to predation in the United States with an estimated cost of $118M. To help alleviate economic losses necessitates avoiding or reducing predator interactions.

With increased interactions between predators and agricultural animals there is also an increased likelihood of predator depredation [California Department of Fish and Wildlife (CDFW) 2013, Morehouse et al. 2018]. For example, in 2015 there was an increase in the application for predator depredation permits in California. During that year, 248 permits were issued for mountain lions, and 101 were killed in the state (CDFW 2016). However, the removal of an apex predator, such as a territorial male mountain lion that is preying upon livestock, can further exacerbate situations. This can increase the risk of predation on livestock by opening a territory to several other competing young male mountain lion (Peebles et al. 2013).

Predators are important for healthy ecosystems, helping to shape the demographics of an ecological community (Berger 2006). Many predators are considered keystone species that can help maintain healthy populations of other wildlife such as deer. A keystone species plays a unique and critical role in the way ecosystems function; without these species, ecosystems would look dramatically different. Carnivores often provide a balance among trophic levels and declines in apex predators can result in ecosystems that are invaded by non-native species (Wallach et al. 2010). To this end, reducing or preventing interactions between predators and livestock can help maintain a healthy natural ecosystem.

Mitigation strategies to reduce interactions between agricultural animals and predators include lethal and non-lethal approaches. Common lethal approaches comprise shooting, snaring, and trapping (Scasta et al. 2017). Although lethal approaches to mitigation have been identified as most effective, there are several non-lethal options that have been reported to be successful, including herding, fencing, guard animals, and stalling animals at night (Scasta et al. 2017). However, there has been a call for more systematic research on wildlife predator management using lethal and non-lethal methods (Johnson and Wallach 2016); additionally, there is an identified need to develop effective mitigation strategies that balance natural ecosystem stability with sustainable animal agriculture (Goldfarb 2016).

### 4-H Animal Science Projects

The 4-H Youth Development Program is a national nonformal youth education organization that is administered through Land Grant Universities in each state (Borden et al. 2014). The focus of 4-H programming is to advance Positive Youth Development through activities, projects, and programs in out-of-school time settings (Campbell et al. 2013). 4-H utilizes a "learn-by-doing" approach to its programming, emphasizing the advancement of knowledge and skills through experiential methods and the application of learning to community needs (Carver and Enfield 2006).

Established around the turn of the 20th century, 4-H has an extensive history of offering science-based projects and activities for youth, particularly in the areas of production agriculture (Enfield 2001). On an annual basis, 4-H Animal Science projects have one of the largest enrollments nationally: approximately 1.5 million youth [Research Education & Economics Information System

(REEIS) 2010, 2014)]. Most 4-H Animal Science project animals, mainly livestock and poultry, can be considered of the backyard variety with approximately 8-9 animals of the same or mixed species (Smith and Meehan 2012).

In California, over 50,000 4-H youth participate in Animal Science projects annually (Lewis 2018). Based on predator-livestock interactions reported by researchers and 4-H educators in California (Quinn and Vickers, pers. commun., Zediker, pers. commun.), the curriculum in Cheung et al. (2019), was developed to help address these issues. The overarching goal of the curriculum is for participating youth to develop knowledge and skills that help reduce risks associated with predator-livestock interactions and their 4-H project animals; furthermore, the curriculum includes a service-learning component whereby youth apply their new knowledge and skills to help address predator-livestock issues in their communities through animal husbandry.

## METHODS

### Curriculum

The goal of this investigation was to collect pilot outcome data on the 4-H curriculum (Cheung et al. 2019). The curriculum comprises five sequential modules: *Biomes and Habitats*, *Food Web*, *Predator Identification*, *Risk Assessment and Mitigation*, and *Service-Learning and Application*. Mitigation strategies emphasized in the curriculum focus on non-lethal means.

Curriculum implementation occurred in collaboration with a County 4-H Program in Northern California. 4-H youth participants (six females, one male) were recruited by the County 4-H staff member. Youth were members of four different 4-H clubs, lived in rural and suburban areas within the county, and had experience with a variety of 4-H Animal Science projects, including livestock and poultry. Youth participation in this project was voluntary; all research methods were approved by the UC Davis Institutional Review Board**.**

The 4-H staff member facilitated the curriculum with the 4-H youth participants over a period of two weeks. After curriculum implementation was completed, the 4-H youth worked to complete their service-learning project and shared it with community members and groups over a period of approximately three months.

### Research Design

A sequential explanatory mixed methods research design (Creswell and Clark 2017) was used to answer the research questions. The first phase of this inquiry was quantitative, using retrospective survey data to measure the influence of the curriculum on participating youths' acquisition of content knowledge presented in the five activity modules. A retrospective survey design was used to minimize issues of response-shift bias and thus measure outcomes from participants' experiences more accurately (Raidl et al. 2004).

The specific quantitative research question was: What influence, if any, does the experientially based curriculum using guided inquiry have on participating 4-H youths' content knowledge related to predator/livestock interactions?

The second phase of the investigation was qualitative, drawing upon data from focus group interviews with study participants to assist in the interpretation and explanation of the survey outcomes. The focus groups were held via Zoom video conference. The qualitative research question was: What learned materials contributed to the youths' service-learning project and their own practices as livestock and poultry owners?

## RESULTS

### Quantitative Outcomes

Paired t-tests from five retrospective surveys, one for each curriculum module, revealed significant increases in mean scores across all modules (Table 1). Significance level was set at $p < 0.05$ (IBM Corp 2017). The increase in mean scores for all modules from pre- to post-intervention illustrated a self-reported gain in content knowledge understanding (Table 1).

**Table 1. Summary of Paired t-tests for Retrospective Surveys.**

| Curriculum Module | Pre-Mean (SD) | Post-Mean (SD) | t | df | Sig (2-tailed) |
|---|---|---|---|---|---|
| 1 | 2.49 (0.92) | 3.77 (0.49) | -7.77 | 34 | 0.000 |
| 2 | 3.0 (0.80) | 3.77 (0.49) | -5.41 | 34 | 0.000 |
| 3 | 2.57 (0.74) | 3.71 (0.46) | -8.58 | 27 | 0.000 |
| 4 | 2.82 (0.61) | 3.89 (0.32) | -9.38 | 27 | 0.000 |
| 5 | 3.28 (0.61) | 4.0 (0.0) | -5.87 | 24 | 0.000 |

### Qualitative Outcomes

Focus group data were analyzed inductively using the constant comparison method (Dye et al. 2000) whereby themes and patterns emerged from the coded data as opposed to assigning *a priori* categories (Patton 2014). Where relevant, some codes were combined based on generalizations during data analysis (Hatch 2002). Four major themes were identified from the focus group data: community impacts of predation, application of knowledge and skills, sharing knowledge and skills, and useful aspects of the curriculum.

#### *Community Impacts of Predation*

Participating youth inferred that if predation impacts them, it will also impact their neighbors and community. Additionally, they shared their thoughts on community members working together to help reduce predator/livestock interaction issues. Salient quotes from participants included:

- *I thought about how if my animals were in danger I could help. It wouldn't be much different if my neighbor's animals were in danger, too. So, I could help my neighbors and my community with what I learned in the curriculum.*
- *I think the way this has affected our community is that it's important to share what we've learned with our neighbors. In order to keep our animals safe, it's kind of a group project.*

### *Application of Knowledge and Skills*

Youth participants applied new knowledge and skills by implementing or planning to implement specific animal husbandry techniques as part of their own practice. Examples included: installing motion lights; placing latches on chicken coops; improving goat housing (e.g., using sturdier materials); and covering their animals' feed at night. Relevant quotes included:

- *I saw when I went home to my animals and would feed them, I was really looking around at where they lived and how I could help them.*
- *Before, I didn't have a latch on my chicken coop. I lost one of my chickens because the door got opened when I didn't have a latch on it. After doing this [curriculum], I'm glad I learned about that.*

### *Sharing Knowledge and Skills*

Youth participants also applied what they learned from the curriculum to the development of an informational video for their service-learning project. Participants presented their video to other 4-H groups and community members. One youth commented:

- *I think I would've like to [have had this video information] for my first year [in 4-H] because it would've really helped me.*

Participating youth also identified additional ways they could share their new knowledge with other 4-H youth and community members. Representative youth comments included:

- *We can make a page and put it onto the 4-H website. It would be about what we learned.*
- *We can [distribute] posters around our community or school. If someone is wanting to build a new pen, they can contact the 4-H office or us who did this program.*
- *If we're having a dinner or a party [with friends] at our house, we can talk to them about [what we learned].*

### *Useful Aspects of the Curriculum*

Participants stated that specific curriculum activities were particularly useful in helping them understand and apply concepts. Among these included: the food web activity; skull and track activity; predator/prey scenarios; and the risk assessment tool. Many participants shared that the skull and track activity would help them identify whether a predator was present and determine what kind of predator it might be. The predator/prey scenarios and risk assessment tool helped youth connect the curriculum content to their home environments and animal husbandry practices. Related quotes included:

- *It was nice to go back to my house and look at the problems I could potentially have with predators with my [animal's] shelter and [other aspects of my husbandry practices].*
- *The [animal] track curriculum was pretty cool because we learned how to identify tracks from [predator and prey] animals.*

## DISCUSSION

Effective curricula represent a foundational element of educational programming in Cooperative Extension, including 4-H (Smith et al. 2017). Most of the content knowledge gained by youth in this investigation using the curriculum (Cheung et al. 2019) was centered around understanding and mitigating predator issues using non-lethal strategies as they related to 4-H project animals. From a theoretical perspective, youth developed their new knowledge through constructivist-based learning whereby new knowledge is constructed by individuals through the interaction of prior understanding and beliefs with new ideas, events, and activities (Fosnot and Perry 1996). All activities in the curriculum were designed using guided inquiry, a constructivist-based learning strategy (Colburn 2000); additionally, the curriculum modules were sequenced in order to help youth build knowledge and skills over time and provide youth with opportunities to apply what they learned in real-world situations (Tyler 1949, 1977).

Participating youth applied new knowledge and skills to their own 4-H Animal Science projects because it was personally relevant. On a larger scale, however, the 4-H youth in this project connected their knowledge and skills to predator/livestock interaction issues on a community level. This was accomplished through a service-learning project that involved the development of an informational video that was shared within their communities. Furthermore, this service-learning effort incorporated many of the standards of high-quality service-learning for K-12 youth identified by The National Youth Leadership Council (NYLC) (Kielsmeier 2011). Specifically, three NYLC standards can be highlighted: The first one is meaningful service (Kielsmeier 2011). The 4-H youth shared that they believed their video would benefit other members of their communities. The second standard was that the service-learning project was linked to a curriculum (Kielsmeier 2011). Concepts from the curriculum were included in the informational video. The third NYLC standard that was unmistakable in the service-learning project was reflection (Kielsmeier 2011). Throughout the process of developing their informational video, the participating 4-H youth were engaged in the process of reflection.

## CONCLUSION

"Tell me, and I will forget. Show me, and I will remember. Involve me, and I will understand" (Seigel and Rockwood 1993). The constructivist activities in the Cheung et al. (2019) curriculum, as well as applications of new knowledge and skills to their own animal husbandry practices and their communities, helped participating youth develop an understanding of predator-livestock issues and non-lethal mitigation strategies to help address them. The curriculum could help 4-H youth who raise livestock and poultry improve their animal husbandry practices; additionally, the curriculum may serve as a resource for other youth-serving organizations involved in animal agriculture. Lastly, the curriculum could, potentially, serve as a model for future 4-H curricula across other subject matter areas with respect to the intentional inclusion constructivist-based strategies and a service-learning component.

## LIMITATIONS

One major limitation to this investigation was the small sample size. Due to this small sample size, generalizations beyond the scope of this project cannot be made. Another potential limitation was the duration of youth engagement in the service-learning component. Previous research by Yamauchi et al. (2006) found that at least 40 hours of exposure to service-learning are needed to see benefits (Scott and Graham 2015). By the end of this study the participants in this investigation had not spent 40 hours on their service-learning efforts. However, despite the limited duration of their service-learning experience, participating youth did complete their video project and planned to continue sharing it within their communities. To address these limitations, future investigations studies should be conducted with larger, more diverse samples over longer periods of time.

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