Love it or list it: Enclosure Alterations affect behavior of Canada lynx at John Ball Zoo

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Introduction

- Felids in zoos are affected by changes in their environments which can negatively impact welfare. Larger, more complex enclosures have been shown to enhance the well-being of cats in captivity
- The behavior of two Canada Lynx (*Lynx canadensis*) was monitored one year after their introduction to a naturalistic enclosure at John Ball Zoo (JBZ).
- Their enclosure includes live vegetation and elevated rock outcrops. Before the second year of our research some trees were removed and part of the elevated rock outcrops was made inaccessible. These areas included "hot spots" the two lynx used extensively in 2018
- The objective of our study was to observe and record spatially explicit behaviors to assess how patterns of behavior changed from summer 2018 to summer 2019.
- We specifically investigated whether active and inactive behaviors changed for each individual. Was either lynx more active in 2019 compared to 2018? Did the location of active and inactive behaviors change?

Methods

- A male and unrelated female Canada Lynx (*Lynx canadensis)* were observed at John Ball Zoo, Grand Rapids, Michigan.
- Specific behaviors were recorded along with the time and location of each behavior using the cloud-based program *Zoomonitor*
- Prior to data collection, all research assistants were trained in use of *Zoomonitor* and tested for inter-observer bias
- Weather, time of day, enrichment, and unusual zoo activity near the exhibit were recorded each session
- Sessions were 30 minutes each. Every 30 seconds, we recorded each individual's location and behavior (state behaviors, e.g., walk, lying down) and all occurrences of event behaviors (e.g., snarl, growl, glance).
- We compared 2018 and 2019 time budgets (% of total time observed) of active and inactive behavior using Chi-square continency tests (2-tailed) and created heat maps that show the intensity with which each location in the enclosure was used for particular behaviors

Results

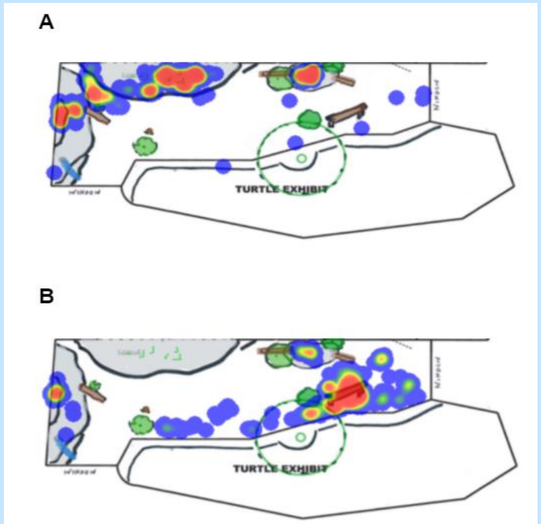

Fig. 1. Inactive behaviors (e.g., lying down, sleeping) for the male lynx from the summer 2018 (Fig. 1A) to summer 2019 (Fig. 1B). Cool colors (blue-green) show areas used infrequently, and warm colors (yellow-red) show areas that were visited most frequently known as "hot spots," represent the male lynx's preferred resting spaces. The male lynx primarily rested on rocks and ledges of higher elevations in 2018, while data from 2019 shows that areas of higher elevation were utilized less, and the male favored a resting spot underneath a log towards the right of the exhibit.

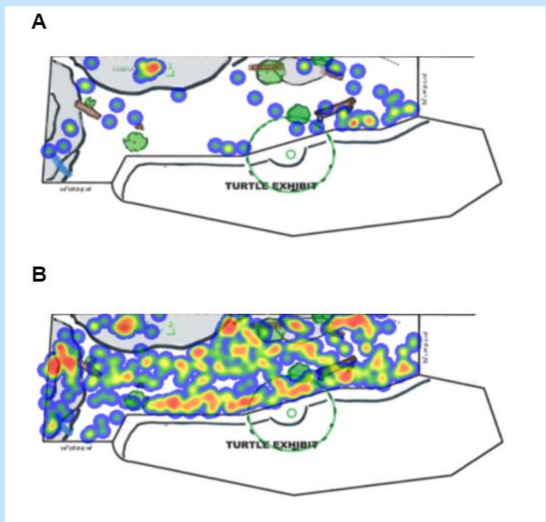

Fig. 2. Active behaviors (e.g., walking, self-grooming) for the female lynx, comparing summer 2018 (Fig. 2A) to summer 2019 (Fig. 2B). Cool colors (blue-green) show areas used infrequently and warm colors (yellow-red) show areas that were used often. Frequently used areas, known as "hot spots," represent the areas where the female lynx was very active. In 2018, the female lynx was often observed near the turtle exhibit (in front) or on the rock outcrop (in back). In 2019, however, the female lynx utilized the entire enclosure, as illustrated by the many hot spots found throughout the enclosure

	Observed	Expected
2018 Inactive Behaviors	1175	1131.79
2018 Active Behaviors	358	401.21
2019 Inactive Behaviors	1897	1940.21
2019 Active Behaviors	731	687.79

Fig. 3. The male lynx was inactive more than active in 2018 and 2019, but was less active than expected in 2018 and more active than expected in 2019 (X^2 = 9.98. $0.005 < p < 0.001$). Overall, the male lynx's behavior was significantly more active in 2019, and he also shifted his spatial use of the enclosure.

	Observed	Expected
2018 Play and stalking	8	31.43
2018 Not play and stalking	1770	1746.57
2019 Play and stalking	68	44.57
2019 Not play and stalking	2454	2477.43

Fig. 4. The female lynx was less active than expected in 2018, and more active than expected in 2019 (X^2 = 30.31. $p < 0.0005$). Overall, the female lynx's behavior was significantly more active in 2019 than in 2018, and her spatial use of the enclosure shifted to include the entire area.

Discussion and Conclusions

- Our study allowed us to quantify the active and inactive behaviors of two Canada lynx at JBZ before and after modifications to their enclosure.
- The male lynx was consistently immobile and hid from visitors under a log. This pattern of inactivity was present in both 2018 and 2019.
- Change in the male's spatial use was dramatic (Fig. 1). We concluded that modifying the spaces available for hiding caused the lynx to change his preferred resting sites.
- The female lynx exhibited more active behaviors (e.g. stalking, playing) and made use of the entire enclosure. These patterns of high activity were not as prevalent in 2018 (Fig. 4). Both her activity levels and spatial use increased during 2019 (Fig. 2).
- We concluded that this change was due to the female becoming more familiar with the exhibit. The reduction in hiding sites encouraged exploratory and active behaviors, leading to the female lynx to make use of a larger portion of the enclosure.
- The difference in behavior and spatial use of the male and female lynx might be explained by their age difference. The female (2 years old) often displays the playful and locomotive behaviors indicative of young cats. The male lynx is a mature adult (6 years old) who often displays inactive behaviors (e.g. laying down, sleeping, sitting) characteristic of older cats.
- Overall, while the reduction of vegetation and rock ledges in the enclosure lead to changes in the spatial use and activity levels of the Canada lynx, both continue to adjust to their environment and are comfortable in their surroundings.

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This protocol was approved by the JBZ Animal Care Committee and the GVSU Institutional Animal Care & Use Committee.