A project for ZOOL 567 (Animal Behaviour) in partnership with AFAC (Alberta Farm Animal Care Association)

By Kaye Bonto

THE STATE OF BEE-ING STRESSED

A short 101 of how to spot stressed honey bees *(Apis mellifera)*

A QUICK BACKGROUND ON COLONY ORGANIZATION

Since honey bees are highly social insects, normal unstressed colonies organize themselves in castes -- where each honey bee has a specific task or role to do in order to contribute to the overall health of the colony.[1]

THE ROLES WITHIN THE COLONY[2]

THE QUEEN

"The mother of all bees," since she is the only female that is able to reproduce.

DRONES

Comprised of all males in the colony with a single role: To leave the hive and mate with a queen from a different hive

WORKER BEES

An all female caste that makes up the majority of the colony.

Responsible for:

- Hive maintenance
- Nursing
- Foraging
- Defense
- Caring for the queen

Studies on honey bees found that behavioural responses to stress are energetically expensive which can disrupt the division of labour mentioned above.[1,3]

Energy expenditure: the amount of energy required to carry out physiological functions.

As such, researchers have quantified stress in terms of how division of labour was altered or if task-switching or task quitting were observed.[1,3]

SOME ENVIRONMENTAL STRESSORS OBSERVED IN HONEY BEE STUDIES[3]

POOR **NUTRITION** | EXTREME **HEAT** | INCREASED **PREDATION** | PRESENCE OF **PATHOGENS**

NUTRITION

Negative effect on cognition required for effective foraging

Can disrupt:

Orientation & Navigation

Choosing high quality patches

Ability to communicate [5]

HEAT

Frequent task-switching to respond to heat.

Cooling behaviour observed such as tongue lashing and fanning.

Less maintenance tasks observed like self-grooming or hive maintenance. [1]

PREDATION

Perceived threat resulted in anxiety-induced states which affected foraging decisions.

Thus, was unable to identify high quality food source.[6]

PATHOGENS

Early transition from nursing to foraging resulted in an inefficient foraging force where bees :[3,7]

Foraged less often

Chose low quality food

BEE-ING CALM VS BEE-ING STRESSED

BEEHIVE-ioural cues that indicate stress in honey bees

CALM (UNSTRESSED) HONEY BEES

No erratic movements
Able to navigate back to the hive [4,5]

Effective waggle-dance communication [4,5]

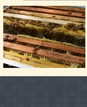
Balanced division of labour [1,3]

Worker bees are calm and able to do necessary tasks such as grooming and hive maintenance.

Calm hum
Very distinct from stressed hum

[M. Moggy, personal communication, November 22, 2021]

Timely transition from larvae to forager [4, 5, 7]



STRESSED HONEY BEES

Non-linear erratic flight [4,5]

Unable to navigate back to the hive

May not be able to recognize landmarks

Infrequent and imprecise waggle-dancing [5]

Switching tasks frequently to respond to stress [1]

Stressed hum
[M. Moggy, personal communication, November 22, 2021]

Aggression towards non-nestmates and other predators [8]

Young foragers @ precocious ages of 7-21 days [4, 5, 7]

REFERENCES

[1] Johnson, B. R. (2002). Reallocation of labor in honeybee colonies during heat stress: The relative roles of task switching and the activation of reserve labor. *Behavioral Ecology and Sociobiology*, *51*(2), 188–196. https://doi.org/10.1007/s00265-001-0419-1.

[2] Honey Bee Research Centre. (2021). Castes of Honey Bees. University of Guelph. https://honeybee.uoguelph.ca/all-about-bees/castes-of-honey-bees/

[3] Bordier, C., Klein, S., Le Conte, Y., Barron, A. B., & Alaux, C. (2018). Stress decreases pollen foraging performance in honeybees. *Journal of Experimental Biology*, 221(4), jeb.171470. https://doi.org/10.1242/jeb.171470

[4] Klein, S., Cabirol, A., Devaud, J.-M., Barron, A. B., & Lihoreau, M. (2017). Why bees are so vulnerable to environmental stressors. *Trends in Ecology & Evolution*, *32*(4), 268–278. https://doi.org/10.1016/j.tree.2016.12.009

[5] Scofield, H. N., & Mattila, H. R. (2015). Honey bee workers that are pollen stressed as larvae become poor foragers and waggle dancers as adults. *PLOS ONE*, *10*(4), e0121733. https://doi.org/10.1371/journal.pone.0121733

[6] Bateson, M., Desire, S., Gartside, S. E., & Wright, G. A. (2011). Agitated honeybees exhibit pessimistic cognitive biases. *Current Biology*, *21*(12), 1070–1073. https://doi.org/10.1016/j.cub.2011.05.017

[7] Goblirsch M, Huang ZY, & Spivak, M. (2013). Physiological and behavioral changes in honey bees (Apis mellifera) induced by Nosema ceranae infection. *PLOS ONE*. *8*(3), e58165. https://doi.org/10.1371/journal.pone.0058165.

[8] Weihmann, F., Waddoup, D., Hölzl, T., & Katsberger, G. (2014). Intraspecific aggression in giant honey bees (Apis dorsata). *Insects*, *5*(3), 689-704. https://doi.org/10.3390/insects5030689.