Sustainable Mini-Livestocking of Acheta Domesticus For Human Consumption to Battle Kwashiorkor

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Introduction

Sanambélé, Mali is a subsistence farming community with a population of roughly 1,200. In 2008, the Sanambélé Health Clinic reported that 23% of the children were considered at risk for kwashiorkor, a form of malnutrition due to a lack of certain essential amino acids in their diet. Under guidance of the holistic process, Florence Dunkel's AGSC 465R class was enlisted to help find alternative food sources for missing amino acids and possibly other micronutrients. *Acheta domesticus* (house cricket) can be easily found in the village, it can eat almost anything, is safe to handle, and has a great potential for mass-rearing (Parajulee et al., 1993). *Acheta domesticus* has been found to contain 62% protein content (Wang 2004). *A. domesticus* can supply the children of Sanambélé with the missing essential amino acids in order to defend against malnutrition. The problem then is how many crickets can be raised on the food available in the village and how many can be harvested on a daily basis without disrupting cricket fecundity and fertility.

Hypothesis

Mini-livestocking with *Acheta domesticus* can be done year-round in a sustainable manner to help alleviate malnutrition and lower the risk of kwashiorkor.

Materials and Methods

Various forms of data collection were employed including database searches for peer-refereed journals, in-depth dialogue with the on-site mentor, Keriba Coulibaly, and Florence Dunkel. The holistic process, ethnorelativism, and appreciation for traditional ecological knowledge were important aspects of this project. Exposure to the culture of Sanambélé was acquired through the films Dancing Across the Gap (Chaikin et al., 2010) and the Cultural Immersion video (Jelenchick and Dunkel, 2008).

Table 1 Projected Hypothetical Cricket Growth -100% Fertility

Generation	#Crickets	#Eggs Produced in 1 Month (29.53 days)
0	50	14,765-29,525
1	22,145	6,539,418.5-13,076,622.5
2	9,808,020.5	2,896,308,453.65-5,791,636,105.25

Assumptions: male:female ratio = 1:1; each female lays 50-100 eggs every 2.5 days; 8-10 weeks are required for egg to adult maturation; 100% fertility (all the eggs hatch).

Figure 1

Figure 2

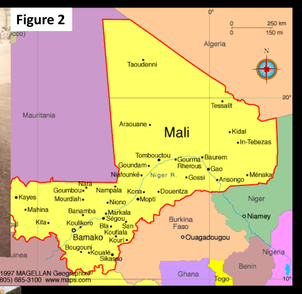

Figure 3

Figure 1: At home in Sanambele, Awa Diarra prepares freshly harvested lettuce for the weekly market in Bougoula. Excess material can be cricket feed. **Figure 2**: Sanambélé is located 50 km south of Bamako. **Figure 3:** Crickets can be found and caught easily around Sanambelean homes .

Table 2 **Sanambélé Planting and Harvesting Schedule**

Crops	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Bambara Ground Nut												
Bananas												
Beans, Common												
Cabbage												
Carrots												
Cashews												
Cassava												
Cauliflower												
Chili Peppers												
Cowpeas												
Cucumber												
Garlic												
Leaf Lettuce												
Leeks												
Maize												
Mango												
Melons												
Millet												
Okra												
Onions												
Peanuts												
potato												
Pumpkins												
Rice												
Shallot												
Sorghum												
Spinach												
Sweet Pepper												
sweet potato												
Tomato												
Watermelon												
Yams												

harvesting season
planting season

Crop residue (leafs, stems, stalks, husks, roots, seeds, etc.) left over from harvest can be used to feed the crickets. (K. Coulibaly 2012).

Results and Discussion

Acheta domesticus is 16-21mm long, their life cycle consists of 3 stages (egg, larva, and adult), and has a lifespan of 2-3 months (Flukerfarms.com). They have a high intrinsic growth rate and can be mass-reared easily in small spaces (Oonincx et al., 2010). They are opportunistic omnivores and their diet is so variable that it is essentially undefinable (Kaufman et al., 1989). They will feed on most organic materials and their efficiency of conversion of ingested food is twice as efficient as chickens and six times higher than cows (Capinera, 2004). The female house cricket lay 50-100 eggs every 2.5 days (Flukerfarms.com). Table 1 highlights the extreme potential speed of *A. domesticus* populations to expand if diet and conditions are perfect with a 100% fertility rate. With such extreme growth, crickets would be available for consumption every day. To achieve population growth somewhat similar to Table 1, the crickets will need a nutritious diet to ensure maximal breeding rates and to pass that nutrition on to the consumer (Kaplan, 2012). Fertility depends on environmental conditions and they will breed continuously if supplied with food, water, and optimal temperatures (Capinera, 2004). The diet available to the crickets will be whatever organic crop byproducts (leafs, stalks, stems, husks) are left after harvests. Table 2 highlights possible cricket food sources by showing planting and harvesting periods of various crops grown in Sanambélé. It appears that harvesting takes place year round, but it is hard to ascertain how much crop byproduct will be available for the crickets' diet. If there is enough to feed large cricket populations then *A. domesticus* can supplement the dominant diet of grain-based tou to make it more nutritious (Bukkens 2005, Turley 2011). If villagers decide not to farm *A. domesticus* year round, they can still rear the crickets during the hunger period when new crops have just been sown and stored produce from the previous harvest becomes limited (Gahukar, 2011). This will at least give the children a food source rich in complete proteins at a time that all regular protein sources will be minimal.

Conclusion

Hypothesis cannot be accepted nor rejected. While it is easy to mass-rear thousands of *Acheta domesticus*, it will be difficult to determine the outcome without experimenting with the environmental conditions and available diet on cricket population dynamics. This will need to be done in order to understand how many crickets can be consumed while ensuring future population replenishment for a constant supply. With a steady supply of *Acheta domesticus*, the diet of Sanambéléan children could contain more of the essential amino acids and other micronutrients needed for growth. The number of children at risk for kwashiorkor will drop but only if crickets can be reared in massive numbers. It is unknown if there will be enough crop byproducts to feed many crickets year round. This is by no means a guaranteed end to malnutrition but it will ensure that the children have an additional food source when times get tough.

Recommendations

- **It will be important to conduct experiments with different cricket diets to discover which diet provides maximum growth and reproduction. Once this is determined, mini-livestocking crickets will be a matter of simplification and repetition.**
- **Have multiple cricket enclosures, one for eggs, one for juveniles, and one for adults.**
- **Only harvest adult crickets and in amounts that can be replaced by older juveniles to ensure a continuous supply.**
- **Be patient! This is a lengthy endeavor and will not generate results over night!**
- **Compile data from my research, Hannah Fraser's research on structure, and Alex Bellingham's research on cricket nutrition.**

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