International Centre of Insect Physiology and Ecology

How I Spent My Summer Vacation

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Since the fourth grade, I have been a 4-H member. Generally, most people in Iowa know about 4-H and that the H's represent the Head, Heart, Hands, and Health. But if you are a scientist working at the International Centre of Insect Physiology and Ecology (ICIPE), '4Hs' are the goals of improving and promoting —human, animal, plant and environmental health—by interdisciplinary teams of scientists working in population ecology and ecosystems science, behavioral biology and chemical ecology, molecular biology and biochemistry, and social science.

This summer I left my 4-H friends and projects at home and became a part of ICIPE's 4H's program in Kenya.

When asked by a local reporter if I had any fears about going to Kenya, my response was "only making my flights." I left the Des Moines International Airport on Monday, June 7th stopping in Chicago and London before arriving in Nairobi, Kenya on Tuesday, the 8th.

Well I made all of my flights with no problems, so I guess my fears were over and I was ready for an adventure.

ICIPE is located about 20 km from Nairobi; the mailing address is Duduville (Dudu meaning any small creeping or flying creature in Kiswahili). Traveling from the airport to the center, I quickly learned that Nairobi is a bustling city with an ultra modern skyline, it is over a mile above sea level allowing for a temperate climate, one of the most important commercial centers in Africa, and that stopping at red lights is treated as optional.

I found the center to also be bustling, as everyone seemed to know that one of my bags did not arrive at the airport with me. More than a hundred people work at the centre, which consists of labs, offices, a library, restaurant, and guesthouses.

My first days were spent learning about the various divisions – plant health, animal health, human heath, and environmental health- and their subdivisions. Much of the basic strategic research is carried out at the Duduville center, with fieldwork being conducted at the major research and training field station at Mbita Point on the shores of Lake Victoria.

International Centre of Insect Physiology and Ecology

Why ICIPE?

Established in Kenya in 1970, ICIPE's founders recognized that the developing countries in the tropics had special problems that were not being adequately addressed by scientists and organizations in the North. Furthermore, there was a serious lack of indigenous expertise to resolve these problems. ICIPE's objectives are:

- To help ensure food security and better health for humankind and its livestock;
- To protect the environment;
- To conserve and make better use of natural resources.

ICIPE’s Mission

Their mission is to help alleviate poverty, ensure food security and improve the overall health status of peoples of the tropics by developing and training in the use of tools and strategies for managing harmful and useful arthropods, while preserving the natural resource base through research and capacity building.

Institutional Goals

To achieve its mission, ICIPE has specific objectives in each of the 4H research areas of human, animal, plant, and environmental health. ICIPE will continue to develop, introduce and adapt new tools and strategies for arthropod management that are environmentally safe, affordable, appropriate, socially acceptable and applicable by the target end-users, with full community participation.

In addition, there are Center-wide goals that span all program areas:

- **Create knowledge:** ICIPE aims to serve as the regional focus for bioscience and technology information and knowledge, and to develop and adapt improved arthropod management technologies.
- **Build capacity:** ICIPE will continue to build the capacity of individual researchers and institutions in the tropics to initiate original research activities as new problems arise; to empower women and harness the youth; and to build capacity to use, transfer and teach ICIPE's technologies.
- **Develop policy:** ICIPE contributes to policy development in areas relevant to its work by cooperating and working closely with African governments and institutions at the local level, and with other policy-making organizations at regional and international levels.
- **Reduce poverty:** The ultimate goals of ICIPE's research are to reduce the impact of arthropod pests that have a direct bearing on poverty, food production and well-being; create sustainable livelihoods for rural communities and entrepreneurs through agribased food, fiber and health products enterprise development; and promote use of beneficial insects.

What they do

- ICIPE's motto 'tropical insect science for development'.
- Together with partners, ICIPE searches for 'effective prevention and smart cures' to help bring about food security, sustainable livelihoods, good health and sustainable use of natural resources for peoples of the tropics. ICIPE helps develop solutions to the problems of peoples of the tropics that are appropriate, affordable, accessible and acceptable.
- ICIPE searches for and develops environmentally safe integrated pest and vector management options that avoid the use of pesticides and synthetic chemicals wherever possible.

- ICIPE builds capacity of individuals and institutions in the tropics to solve their own problems.

How they work

- The agenda for achieving ICIPE's goals is based on the model of ensuring the 4Hs: human, animal, plant and environmental health.
- Carrying the health model a step further, ICIPE stresses 'prevention over cure' when it comes to arthropod-related problems, preferring this to the 'fire-brigade' approach when the problem is already very serious.
- They tackle problems using multidisciplinary teams that include entomologists and acarologists, behavioral biologists, molecular biologists and biochemists, population and ecosystem ecologists, biomathematics and bioinformatics specialists, entomopathologists, biosystematics experts and social scientists and trainers.

ICIPE Donors

ICIPE is funded by a consortium of donors, the Sponsoring Group for ICIPE (SGI), private charitable organizations, United Nations organizations and governmental aid agencies.

Who Am I and Why I am in Kenya

In the fall of 2000, I had the opportunity to attend the World Food Prize Youth Institute as a visitor. On that Saturday, I was in awe as I listened to students present their papers and as the interns spoke of their summer experiences. (I was also in awe at the Carver Center because my dad was the architect.) It was that day, that I knew I wanted to be a part of the Institute and an intern.

I think this is a good time for me to back up and introduce myself. I am Alex Ayers and I am a Senior at Indianola High School. My parents are Richard and Cathy Ayers. We live in rural Indianola.

At school, I am taking college prep and agricultural classes. My future plans include completing a Bachelor of Sciences and a Masters of Science in Agriculture Biotechnology. Then, I would like to attend law school with an emphasis in patent law.

I am an eight-year member of 4-H and a four-year member of FFA. My Supervised Agriculture Experience (SAE) is my breeding sheep. I currently have 11 bred ewes. In the late summer, I evaluate each one and give them a conditioning score. This score helps me determine their nutritional needs to ensure that during their pregnancy they are in good condition. I also do all non-emergency veterinary work myself. Some of my spring lambs will be used for 4-H projects, others will be sold, and some retained for replacement ewes.

My lambs have been exhibited at the Warren County Fair and the Iowa State Fair. In 2003, I earned an Iowa State Fair Showmanship belt buckle. This award is given to approximately five percent of the State Fair exhibitors.

I also help my mom and grandfather on the family farm. Through the years, my responsibilities have included filling planter boxes, helping repair equipment, scouting fields, and auguring corn.

Why did I want to participate in the internship program? Because as I have written my papers for the past three years I have "traveled" the world learning about the need for GMO crops, the Middle East learning about not only the need for water but for quality water, and to Africa where I learned about the typical Ethiopian family.

Now I was ready to actually travel and use my experiences to help and work with others. I know that I will not be able to solve the world's problems, but I can be an advocate for them and teach others.

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My home for the summer was a room in one of the guesthouses. It had all of the comforts of home – two single beds, closet, private bathroom, and television. The restaurant served a choice of foods like fish, beef, ugali, rice, and Coca-Cola. I was soon drinking Kenyan tea with milk and sugar every morning.

During my eight-week stay, I had the opportunity to travel to the Mbita Point Field Station on Lake Victoria for the renaming of the Centre. We drove over roads with huge potholes, that were primarily unmarked, and without speed limits. Other vehicles were mostly trucks and matutus overloaded with passengers. Our travels took us through the Great Rift Valley, small towns, areas of dense forest, and Maasai land.

Lake Victoria is the world's second largest freshwater lake covering an area of 67,850 sq km. This vast expanse, about the size of the Republic of Ireland, forms the headwaters of the River Nile.

Fishing for Tilapia and Nile Perch provides a living for many of the Luo (Kenya's second largest ethnic group) people who live along the lakeside. The fish are sold at local markets or to processors for sale in Nairobi and for export. Most of the fishing is from small dugout canoes, equipped with lateen sails. The boats go in and out from the shore throughout the day and night. At night, their lights look like the lightning bugs we catch in Iowa during the summer.

On June 18, the International Centre of Insect Physiology and Ecology honored its founder director, the late Professor Thomas Risley Odhiambo by renaming the Mbita Point filed station after him.

The scientist at ICIPE also presented the "push-pull' program that uses habitat management to control the stem borer. Kenya loses about 15 percent of its maize and cereals to the stem borer.

Push-pull is a repellent and attraction strategy that uses different plants for the management of cereal stem borers. Companion crops are planted around the maize or sorghum plants. The stem borers are repelled from the main plant (maize or sorghum) and are attracted to a trap plant (Napier or Sudan grass) where they go and lay their eggs.

Stem borers are not the only pests being controlled by "push-pull." The *Stiga hermonthica* plant, which has very pretty pink flowers, is a problem for maize farmers. It attaches its roots to those of the maize, taking away the nutrients that the maize plant needs for growth.

An area farmer could only raise eight bags of maize on his farm of three hectare but for the last three years by using the ICIPE program, he has produced 35 bags.

Push-pull is an alternative to the highly promoted genetically modified crops and meets ICIPE's goals of food security and environmental integrity and sustainable livelihoods for the people of Africa.

On our return to Duduville, Matt, Leanna, Francis and I visited the Maasai Mara Game Reserve, widely considered to be Africa's greatest wildlife reserve. The Mara comprises 200 square miles of open plains, woodlands and forest. Contiguous with the plains of the Serengeti, the Mara is home to a breathtaking array of life. The vast grassland plains are scattered with herds of zebra, giraffe, gazelle, and topi. The Acacia forests abound with Bird life and Monkeys. Elephants and Buffalo wallow in the wide Musiara Swamp. The Mara and Talek rivers are brimming with hippos and crocodiles.

The Mara has been called the Kingdom of Lions and these regal and powerful hunters dominate these grasslands. Cheetahs are also a common sight in the Mara, as are Hyena and smaller predators such as Jackals.

It is an awesome natural wonder, a place where Maasai warriors share the plains with hunting lions, a place of mighty herds and timeless cycles of life, death and regeneration. Wildlife moves freely in and out of the reserve, and through neighboring Maasai lands.

Leaving the Mara we traveled through The Great Rift Valley, which divides Kenya neatly down the length of the country essentially separating east from west. Uninhabitable desert and fertile farmland, flat arid plains and steep escarpments characterize it.

Dr. Saini recommended that I learn about the Maasai people before my arrival. I learned that they are a semi-nomadic people who live under a communal system. Livestock such as cattle, goats, and sheep are their primary source of income. Livestock serves as a social utility and plays an important role in the Maasai economy.

Livestock is traded for other livestock, cash or livestock products such as milk. If a family wants a sheep for slaughter, it can go to another family and trade for a young bull. Individuals, families, clans, and sections establish close community ties using livestock. "Meishoo iyiook enkai inkishu o-nkera"- is a Maasai prayer, "May Creator give us cattle and children.

Only recently, have the Maasi sold some of their livestock products to other groups in Kenya for the purchase of beads, clothing, and grains.

I had a chance to talk to several of the tribe's chiefs and farmers. Many are actually very educated and speak excellent English. All of the children can say hello, how are you and goodbye. You greet the children by patting them on the head.

Upon my return to Nairobi, I planned my trip to the area of Nguruman to do field work. Unlike living at the center, we purchased and prepared our food.

The compound at Nguruman and neighboring farmers were able to connect to a waterline built for an area business. The farmers were able to use the water to irrigate their crops so fresh fruits and vegetables were abundant. Young children with very little effort would cut down bananas for us using a very sharp pungo.

We were walking through the fields and we come to this bamboo looking tree thing. They started cutting down pieces with the pungo, what we call a machete, and then one guy says, "Alex, do you know how to eat this?" while holding the bamboo looking stick. Of coarse I did not because I did not even know what it was. So he cut off a piece about a foot and a half long and hands it to me. He say put it in my mouth and chomp down. I said in response, you want ME to bite on a piece of wood? Yes he does. So I decide what the heck, the nearest dentist is only three hours away, no big deal. I bite down hard and a piece breaks off in my mouth. He says to suck on it but do not swallow it. So I do. It is so sweet. It is raw sugar cane. It tastes soooooo good. I finish the whole foot and a half long piece in 15 minutes.

At the center in Nguruman everything runs on either solar power or natural gas. The refrigerator looks like a deep freezer and runs on natural gas. Gas is used because the power tends to goes out and so the food would spoil. The last night I was there, I was the only one at the station and we had just such a power outage. I had to find my way to the kitchen at about 9:30 in total darkness. The problem is, is that the kitchen is in a completely other building on the other side of the station, so it took a while. When I got there, I lit the stove, which has to be lit with a match anyway, for some light, and tried to find a candle or flashlight. Couldn't find either one so I remembered reading somewhere that it is possible to make a candle with paper, a glass bottle, and some fuel of some sort. All of the Coke bottles are made of glass so the first part wasn't hard. We had a bunch of bags of pembe, maize meal, so finding paper was no problem. The problem was a fuel source. I thought that maybe cooking oil would work, but it doesn't burn well, so I was out of luck for fuel. So, I just stuck the pembe bag paper in the Coke bottle a little ways and made a torch. Which actually worked for a while, or at least long enough for the other people to come back from Nguruman and turn on the generator?

My Project

My project advisor was Dr. Rajinder K. Saini, Principal Scientist and Ag Division Head and Tsetse Research Program Leader. The Animal Health Division has identified a potent repellent for the tsetse fly species *Glossina pallidipes* and *G. morsitans morsitans*. The repellent has been shown to significantly reduce the tsetse challenge (> 80 %) and feeding efficiency (> 90 %) on cattle. It could be used in conjunction with other tsetse control tactics to protect livestock and reduce reliance on synthetic pesticides and the associated resistance development. Particularly promising is a 'push-pull' strategy that uses the repellent to 'push' the flies away from their hosts, in conjunction with baited traps/targets, which 'pull' and kill them.

The Ngu trap is a simple, safe and economical cloth trap for the capture of biting flies (tsetse flies, horse flies, deer flies, stable flies). It was developed at ICIPE's Nguruman Field Station as an environment-friendly alternative to the use of insecticides, following many years of research on appropriate and sustainable technology for African farmers.

It is a passive killing device that works through the attraction of flies to large blue and black objects. Flies simply die from heat exposure after entering into an innovative configuration of cloth and netting.

Together we developed my project. I would:

1. Test Waterbuck Repellent. Odour-baited Ngu traps are about 20-30% effective for two tsetse (*G. pallidipes*, *G. longipennis*), and for two stable flies (*Stomoxys niger niger, S. n. bilineatus*). The traps would be set out in the Nguruman region.

2. Evaluation of farmer/producer participation in the management of tsetse, trypanosomosis in areas of Africa. Personal interviews would be done in the Nguruman and Mombassa regions.

African Trypanosmiasis Background

African trypanosomiasis is the single most important vector-borne disease-affecting people, livestock, and crop production in sub-Saharan Africa. In the 36 African countries that Tsetse Flies inhabit some 60 million people are at risk of being infected. An estimated 20,000 to 25,000 people die each year from Trypanosmiasis.

Commonly called “African Sleeping Sickness”, Trypanosmiasis, is spread through a blood parasite. It develops in two forms in humans: Gamiense Sleeping Sickness, the more common of the two is found in West and Central Africa and is considered chronic and Rhodesiense Sleeping Sickness which is much less common and occurs in Eastern Africa.

The most common occurrences for the Gamiense Sleeping Sickness are near sources of water such as rivers, lakeside villages, and near vegetation covered roadsides. Rhodesiense Sleeping Sickness is spread more by the savanna species of Tsetse and infect mostly animal in the open areas such as cattle and goats, along with humans such as farmers and herdsman.

The presence of tsetse in the tropical Africa has a tremendous impact on cattle breeding. Nagana is the name the native population gives to cattle trypanosomiasis. Imported cattle such as the Zebu are very sensitive to trypanosomiasis and after infection they rapidly lose weight and die within several months. This is the major reason why it is very difficult, if not impossible, to breed cattle within the tsetse belt, especially since there are many nomadic tribes in Africa that move from one place to another with their animals by which it is very difficult to avoid contact with tsetse.

Losses in meat production, milk yield and field work are estimated to cost approximately US$ 500 million annually and, if lost potential in livestock and crop production are also considered, the disease costs Africa an estimated US$ 5 billion per year (1994 prices). Complete control of tstetse would result in an increase in beef production of 1.5 million tons per year. However, this could also have a massive impact on the use of land and on significantly reduce the possibilities for wild life in Africa.

Tsetse Flies transmit Trypanosmiasis by biting and feeding on an infected host. The parasite then is carried in the fly where it spreads to the salivary glands. When the fly then feeds, again the parasite is injected into the new host and then multiplies inside the host. Approximately 5% of tsetse flies carry the Trypanosmiasis parasite.

The infection rate of human sleeping sickness is less than 0.1%. However, Nagana in cattle is much more common because cattle are bitten approximately 10 times a day. Over the period of a month the cattle would be bitten by 10 infected tsetse flies and the chance of being infected are increased. Cattle in tsetse-infested areas are bitten up to a hundred times a day increasing the infection rate at astronomical rates. Tsetse Flies are not known to carry any other diseases.

Tsetse Flies cause substantial amounts of damage to farmers every year. 20 years ago, nearly 80% of Kenyan farmer's cattle died from Trypanosmiasis. Traps can kill up to 99% of tsetse flies that threaten communities. Barriers can also be established that can effectively control areas to protect livestock and villages. In one case, a Barrier of 10 traps killed 20,000 Tsetse flies a day. Barriers are Effective because it increased the mortality rate above the birth rate of the Tsetse Fly.

No vaccine is available for Trypanosmiasis. Only drugs to cure it are available. Most drugs are also over 40 years old and do not work as well as they did initially. Vaccines have not been developed because of the parasites unique biology. It can change the structure of its outer coating, so that when the immune system responds to it, it changes to another form making it extremely hard for the immune system to fight.

Some cattle have formed a small resistance to Trypanosmiasis, no cattle are completely tolerant. This further proves the necessity to control tsetse. Although tsetse are attracted to specific cattle over others. Usually older cattle are more appealing to tsetse than other cattle.

Tsetse was determined to be the cause of the Trypanosmiasis parasite in 1894. Because tsetse has only been known for a little over a hundred years to transmit the Trypanosmiasis parasite, it has been difficult to develop a good method of control. Because tsetse covers 10 million square kilometers of Africa, it would take the eradication of tsetse from 100,000 square kilometers a year for a hundred years to eradicate them. With tsetse having only been known about for a little over a hundred years and control only been around for 50 years, with these numbers it is difficult to eradicate tsetse. In addition, eradication of tsetse is more than a matter of simply killing them. Geographical and political reasons have also made it difficult. In Zimbabwe Tsetse were eradicated three times in the past hundred years. First in the late 1800's, a large-scale epidemic of disease killed most of the wild hosts. Later in 1950 large-scale use of, the now banned, DDT was used to kill tsetse. The last time after the war for independence tsetse was forced back out of the country.

<u>Waterbuck/Synthetic Repellent Validation Experiment</u>

<u>Supplies</u>
10 NGU Traps (Developed by ICIPE)
Bait:
- Acetone
- Cow Urine

Repellent:
- Waterbuck Repellent
- Synthetic Repellent

Explanation of Experiment

This trial is used to validate if the waterbuck repellent works. In addition if it does work does it work better than the previous synthetic repellent, and if combined with the synthetic does it work even better. If the repellent works it will be used on cattle to repel the Tsetse fly.

In the experiment the repellent will be used to try and deter the Glossina Pallidipes, Glossina Brevipalpis, Glossina Austeni, and biting flies. 10 traps will be used in two areas for replication. Five traps will be used in each area. The first trap is a control with no bait or repellent. The second trap is a control with bait but no repellent. The Third trap will have the waterbuck repellent and bait. The fourth trap will have the synthetic repellent and bait. The fifth trap will have a combination of the waterbuck and synthetic repellents and bait. All traps but the first will have Acetone and cow urine for bait. Bait will be used on the traps to simulate a live target (Cattle).

Experimental Process

Two areas will be used.
In each area five traps will be placed in various locations.
Each location must be similar to the location of the same name in the other areas, i.e. if Trap C in Area 1 is in brush, Trap C in Area 2 must also be in brush.
The traps will be as follows:

Trap A: No bait or repellent as a control
Trap B: Bait and no repellent as a control
Trap C: Bait and Waterbuck Repellent
Trap D: Bait and Synthetic Repellent
Trap E: Bait and a combination Waterbuck/Synthetic repellent

Everyday the traps must be moved to the location of the previous trap. The traps will move in rotation according to the Latin Square Design.

5 X 5 Latin Square Design (LSD)

Rep 1	Day 1	Day 2	Day 3	Day 4	Day 5
Site 1	A	D	B	C	E
Site 2	E	A	D	B	C
Site 3	C	E	A	D	B
Site 4	B	C	E	A	D
Site 5	D	B	C	E	A

Rep 2	Day 1	Day 2	Day 3	Day 4	Day 5
Site 1	C	B	D	E	A
Site 2	A	C	B	D	E
Site 3	E	A	C	B	D
Site 4	D	E	A	C	B
Site 5	B	D	E	A	C

By rotating the locations of the traps this ensures that values are not altered by the different Tsetse Fly populations. Each day the number of flies in each location must be recorded, and then the Values will be compared. From those trapped it will be determined the species of each fly and if any specific odor is more repulsive to a specific species of Tsetse Fly.

Results

	Glossina Pallidipes				Glossina Longipennis				Biting Flies	Total
	Males		Females		Males		Females			
Trap	Teneral	Non-teneral	Teneral	Non-teneral	Teneral	Non-teneral	Teneral	Non-teneral		
A	10	76	10	293	0	0	0	0	24	**413**
B	50	643	24	1729	0	0	0	0	66	**2512**
C	9	84	17	265	0	0	0	0	150	**525**
D	19	166	13	422	0	1	0	0	57	**678**
E	7	57	13	161	0	0	0	0	139	**377**
A	19	329	16	660	0	0	0	1	101	**1126**
B	40	1548	33	2228	0	3	0	3	207	**4062**
C	23	303	23	523	1	5	0	3	423	**1304**
D	21	477	22	981	0	1	0	0	271	**1773**
E	11	119	17	235	0	1	0	1	445	**829**
										13599

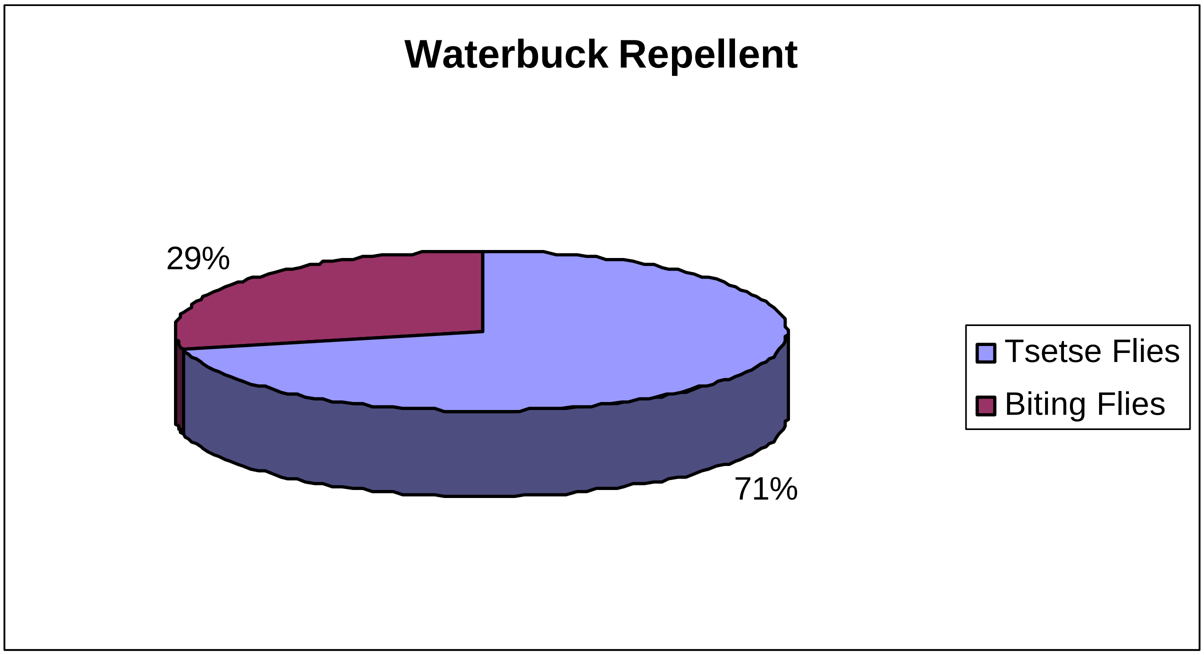
Trap	Flies Caught	**% Caught**
Trap A	1539	**76.59%**
Trap B	6574	**0.00%**
Trap C	1829	**72.18%**
Trap D	2451	**62.72%**
Trap E	1206	**81.66%**

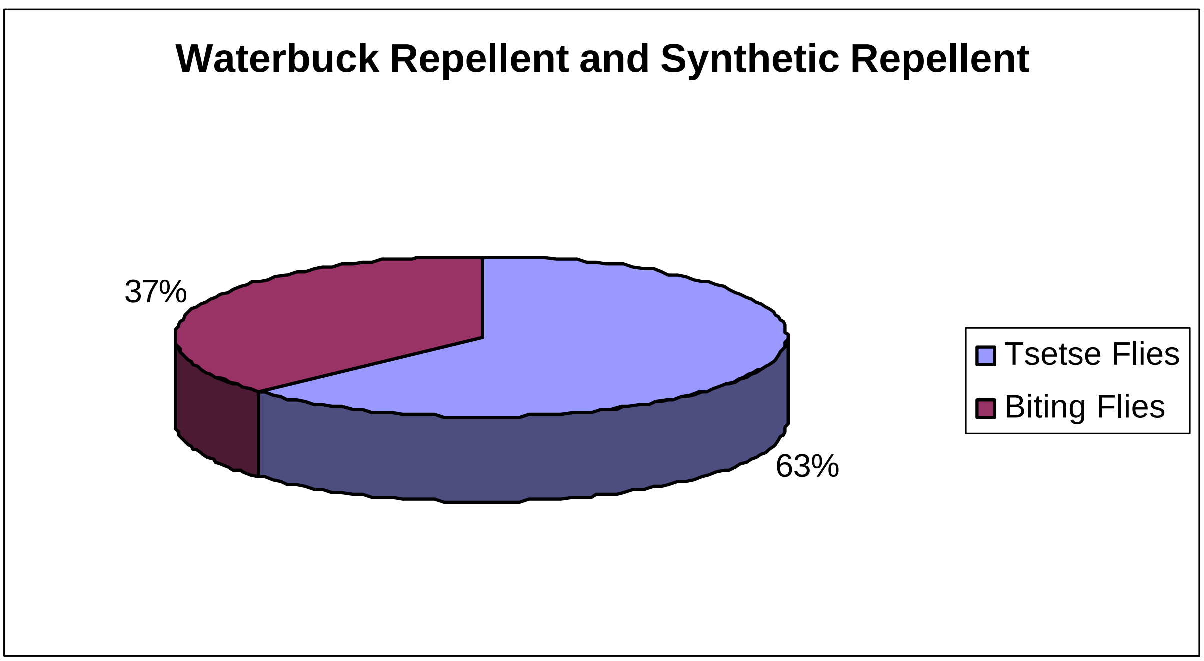
t Grouping	Mean	N	Treatment
A	693.40	10	B
B	212.30	10	D
B	142.40	10	A
B	125.60	10	C
B	62.20	10	E

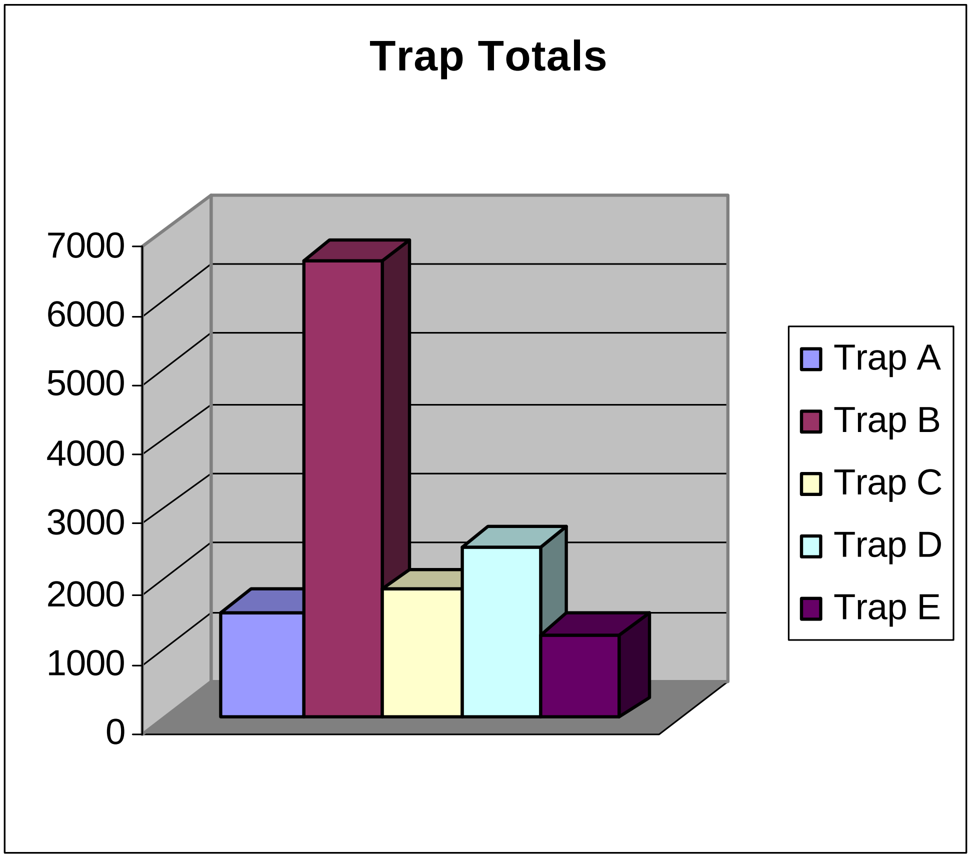
Dependant Variable Variation

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Site	1	174404.180	174404. 180	5.57	0.0232
Treatment	4	2603070.480	65.0767.620	20.79	<.0001
Day	4	132709.480	33177.370	1.06	0.3888

*Any value in the last column greater than 0.05 is ignored as a source of variation


Waterbuck Repellent
29%
71%
Tsetse Flies
Biting Flies


Waterbuck Repellent and Synthetic Repellent
37%
63%
Tsetse Flies
Biting Flies



Conclusion

This project aims to reduce the tsetse fly population through the use of the ICIPE trapping technology to control trypanosomiasis (the deadly Nagana illness for the cattle). By this insect control method livestock health and productivity can be improved and an increase of agricultural production and improved milk yields can be reached.

In this experiment, the objective was to find if the Waterbuck Repellent preformed any better than the Synthetic Repellent and to compare it to the combination of Waterbuck and Synthetic Repellent. By using a Latin Square Design experiment it is possible to determine which of the variables performs best. With the control of cow urine and acetone it is possible to compare the number of flies caught to the number of flies attracted by the cow urine and acetone. With this comparison to the unbaited trap it is then possible to conclude that the repellent masks the attractive aldehydes released by the cattle. Also in comparison between the three repellent treatments there was no real difference

Evaluation of farmer/producer participation in the management of tsetse, trypanosomosis

Twenty farmers from the Rift Valley and Mombassa areas were personally interviewed.

They were asked

1. The number of cattle, sheep, goats, chickens and donkeys they owned,
2. General benefits
3. General livestock problems
4. Pests of livestock
5. Signs of ill health
6. Control methods
7. Drugs used/types
8. Administrated by
9. Costs per month
10. Problems with drugs
11. Identification signs and types tsetse
12. Sites of abundance (sources of tsetse)
13. Population dynamics
14. Times of Biting
15. Most Preferred animals
16. Control Methods
17. Traps – see one, if so where
18. Traps – used one, provided by whom
19. Traps – Problems

Interview Results-

1. Farmers in the Rift Valley had cattle, goats, sheep, and donkeys. Farmers in other areas had cattle, goats, and chickens.
2. Animals were a source of food, income, used for plowing, manure
3. 100% replied that disease and sickness were major problems. Diseases included trypanosomosis, foot and mouth, high calf mortality
4. Ticks and tsetse flies were identified by 100% of the farmers with additional pests being wild animals and worms.
5. Lack of appetite, dry mouth, hair loss, hair upright, weakness
6. Dipping was the most common control method
7. A variety of drugs was used
8. Smaller farmers administrated the drugs themselves while larger herds received their drugs/treatment from vets
9. Costs were from 300 to 1500 Ksh ($3.50 – $20.00)
10. Overdosing and difficulty getting drugs were the most common problem with drugs
11. Cattle running and swishing of tails
12. Most farmers grazed in bush areas
13. Populations were “a lot”
14. Morning and evening were reported as worst times for biting

15. Cattle
16. Dipping and trapping
17. More than half had seen traps
18. Farmers from the Rift Valley had seen and were using the traps they received from ICIPE
19. Wind, children, baboons were common problems for the traps

Conclusions

The farmers were very aware of the effects of the tsetse flies and used drugs to treat the problems. Results from the drugs were not always satisfactory and there was concern about overdosing of animals.

Many of the farmers that replied about the concern of overdosing also used veterinarians to administer the drugs.

Burning of bush was also used as a method of controlling ticks and flies. Others grazed animals in the late morning to early afternoon to avoid the worst biting periods.

Reflections

I could not wait to be asked what I did this summer. Being a Borlaug-Ruan International Intern was an opportunity that I will always remember and be proud of. I learned so much about myself and the many things that we Americans take for granted.

I saw a country that was very beautiful but that also had an ugly side. I will remember the sight of the animals at Maasai Mara, the sun setting over Lake Victoria, and sadly children begging, poor sanitary conditions, inadequate housing . . . . .

My experiences have opened my eyes to what people in under developed countries must endure to complete their daily tasks. I commend the noble individuals of the various scientific centers and agencies and what they do to help the people of those countries.

In my future career I hope to be a member of the scientific community that finds ways to help ensure food security, protect the environment, and alleviate poverty.

For now, I can only use my experiences to help others in my school and community be aware of the work that must be done so that the people of underdeveloped countries have their basic needs meet.

Finally I would like to thank the World Food Prize and John Ruan and Norman Borlaug for giving myself and the other students this chance to see and experience the world from another perspective.

I would also like to thank ICIPE for allowing me and previous and future interns to come to Kenya and learn all about the work that they do to help the people of Africa.

And thank you Lisa Fleming for keeping track of all of us all around the world. I know that it is because of you, that there is less worrying done by many parents