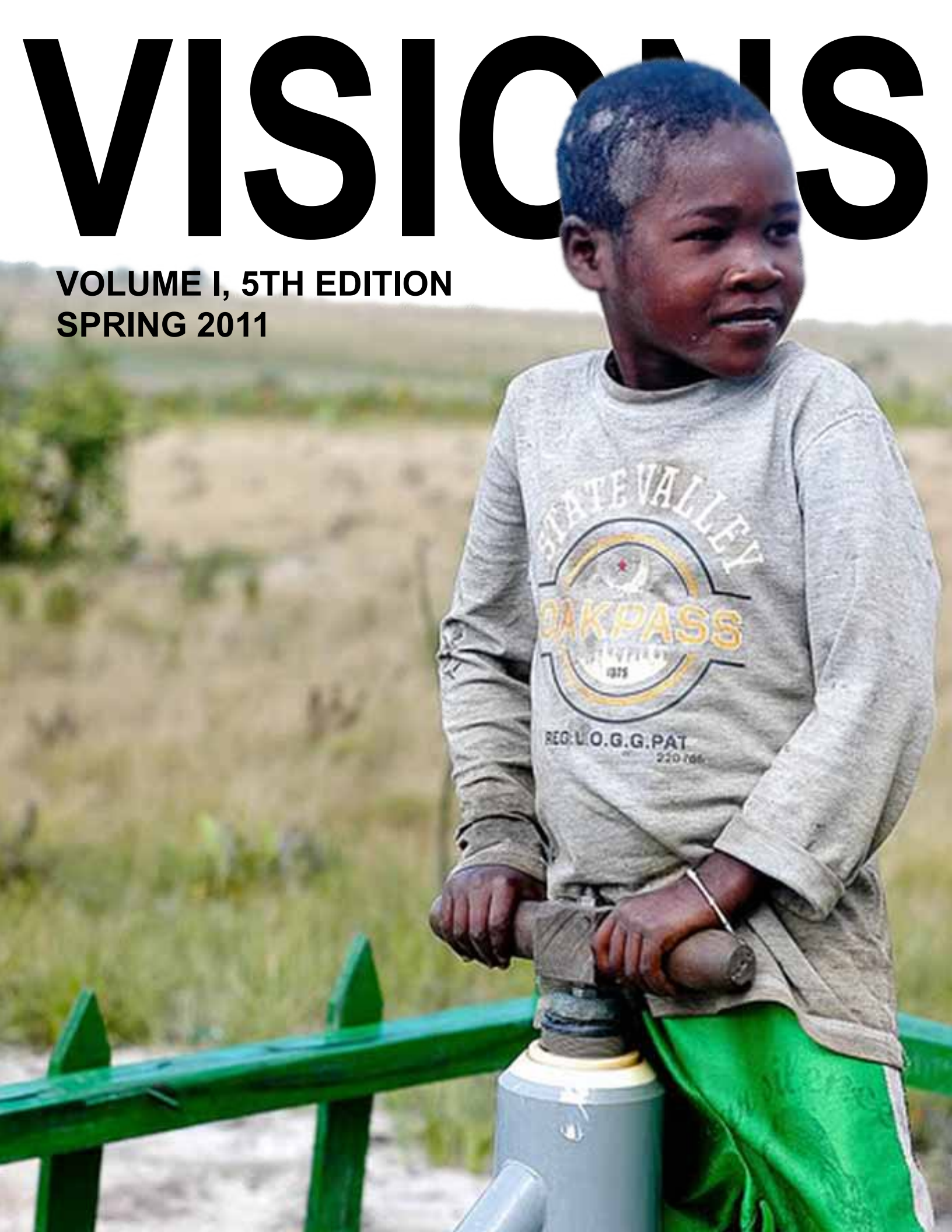


# VISIONS

VOLUME I, 5TH EDITION  
SPRING 2011



VISIONS MAGAZINE is dedicated to the world we live in and the world we hope to create. *Visions* is a non-partisan, peer-reviewed publication that contains articles from disciplines associated with environmental studies. Just a few of these disciplines include communications, political science, economics, philosophy, religion, art, and English. *Visions Magazine* is a faculty-student organized and operated publication that features the works of Elon University students and student-faculty collaborations. The ultimate goal of *Visions* is to allow students to explore scholarly research, writing, and review in a professional setting. In addition, *Visions* provides the opportunity for students with interests in the environment and sustainable development to publish their work.

*Visions Magazine* seeks compelling, interesting, well-written, creative contributions on environmentally related topics. Major contributions to the magazine should be grounded in scholarly literature and/or reflect the conventions of research and writing associated with a specific academic field of study. All submissions must receive positive blind peer reviews before consideration for publication. We discourage submissions that are political or purely editorial in nature. For the next issue of *Visions*, we are especially interested in fiction, poetry, and photographic submissions.

Submissions for the Spring 2012 volume of *Visions Magazine* are being accepted! Please go to <http://org.elon.edu/sustainability/visionsMag.html> for more information about the criteria for submissions and information about the magazine.

Cover photo by Taylor Foshee

# VISIONS MAGAZINE

Spring 2011, Vol V

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# IN PURSUIT OF SUSTAINABLE DEVELOPMENT

Photos and  
Story By  
Taylor Foshee



*As the sun rises across southern Madagascar, the women and children of Mahialambo begin a four-hour journey to retrieve firewood.*

## ABSTRACT

*As the international community continues to seek solutions to end global poverty and environmental degradation, non-profit organizations are looking to make a difference through partnerships, rural empowerment, and education. This article focuses on the work of a non-profit based in the United Kingdom called Azafady, which has been working with communities in the town of Fort Dauphin and rural villages in the extreme southeast of Madagascar for more than ten years. Fort Dauphin is the urban centre of Anosy, one of the country's most isolated and impoverished regions. The Anosy region is also home to some of the island's largest and most endangered remaining tracts of continuous pristine forest, and served as the site of the author's summer field experiences in 2010. This mix of extreme poverty and astounding biodiversity of flora and fauna made the area an ideal setting to gain a better understanding of development challenges.*

More than a billion people live within the world's nineteen biodiversity hotspots, and over 90% of those who live on less than a dollar a day depend fully or in part on raw environmental products for their livelihood (IUCN 2004). Madagascar ranks among the top nations both for its rates of biodiversity and poverty, serving as a central case in the study of sustainable development. Madagascar is one of the "hottest" biodiversity hotspots in the world, with over 10,000 endemic vertebrate and plant species, which respectively account for 2.8% and 3.2% of the total world's species (Myers et al. 2000). In stark contrast with the nation's environmental abundance, the Malagasy people continue to struggle to eradicate extreme poverty. Over 75% of the rural population lives on less than 1.25 dollars a day ranking Madagascar among the most impoverished countries in the world (World Bank 2009).

These staggering statistics are visible in the daily lives of Mahialambo villagers. Situated

between rolling mountains and a vast expanse of grasslands leading eventually to the Indian Ocean, Mahialambo is obscured from view off of the one-lane road which services all transport to and

from the city center over 20 kilometers away. It is here in the heart of Madagascar that the challenges of rural life are most visible to an outsider. While the hardship can be overwhelming, many communities are beginning to challenge these conditions as status quo and are pursuing new and innovative strategies to improve their livelihoods. With the help of organizations like Azafady,

Mahialambo is making its first steps towards an improved future.

Speaking with the village chief, the author learned that the ever-expanding grassland was once a dense and lush forest. At the age of 60, the chief can remember when he could still see trees from his home. In recent decades, however, the villagers' need for fuel wood and pasture land has increased, placing an ever-growing burden

**More than 75% of  
the rural population  
in Madagascar lives  
on less than  
\$1.25 a day**



*From the top of King's mountain, overlooking the village of Mahialambo (below) and the Indian Ocean.*





*A young boy and girl collect firewood to be used as fuel for cooking and purifying river water for drinking. Collecting firewood can be a tedious process for some, requiring long trips into the forest.*



on the village's women and children, for whom collecting firewood is a primary responsibility. In Mahialambo, the trek to collect firewood is four-hours and provides enough fuel for only 1 to 2 days.

Children comprise more than half of the village's population and often suffer chronic malnutrition, diarrhea, and parasites due to poor sanitary practices that stem in part from fady, the taboos of the ethnic group and region. Human excrement is considered 'untouchable' and its concentration near one's home is perceived as unclean, causing villagers to shun the use of latrines. Instead, villagers defecate in designated areas separated from the living and agricultural areas. These sites, however, are based on tradition rather than strategy. In one case, a defecation site was located on a hillside obscured by brushy vegetation. While the hillside provides privacy and easy access, the rains wash waste down into the river from which most of the drinking and cleaning water is collected. This poses a significant health risk to villagers, who do not consistently have the additional firewood needed to boil water to sanitize it for safe drinking.

Recognizing the challenges of communities like Mahialambo, the non-profit Azafady is working to educate and empower villagers through the provision of culturally-appropriate, environmentally-friendly



*A woman weaves reed mats and baskets to be taken to Fort Dauphin and sold. These crafts provide the majority of family incomes in Mahialambo.*

technology. Azafady's primarily Malagasy-based staff understands local women's needs and has trained them to make hand-molded, fuel-efficient stoves from locally-available materials (clay, sand, zebu cow patties, and water). The mixture used to make the stoves sets in two weeks and retains more heat and energy, thus reducing the amount of firewood burned. This gives women somewhat more time to focus on raising household income through craft production and can encourage some families to send their children to school rather than to collect firewood.

Improving sanitation is more difficult, given local habits and taboos. Azafady worked with local people to construct a latrine facility for a newly inaugurated school as well as individual latrines (known as SanPlats) for important families in the village. These villagers serve as "ambassadors" of sorts to the unfamiliar practice, and help to promote more latrine construction throughout the village. The use of latrines is slowly being accepted and embraced, but as with any social norm, it is hard to change people's minds.

*The future of Mahialambo rests with the next generation and the continued support of community organizations.*







*A typical Malagasy kitchen.*

Azafady and other non-profits assist the people of Madagascar in efforts to achieve the United Nations Millennium Development Goals (MDG) as described in the Government of Madagascar's "Madagascar Action Plan" (MAP), a strategic framework for economic growth and environmental stewardship, that seeks to reduce poverty by 50% between 2000 and 2015 (Azafady, 2009). Although most MDGs will not be met by 2015, incremental change is being made that positively impacts the lives of not only the rural poor, but also the volunteers who get to know them. Three months in Mahialambo gave the author a new appreciation for the hard work and challenges facing impoverished communities. Despite a lack of resources, the people were generous and gracious hosts.

Follow-up studies are a frequent shortcoming of development work (Easterly 2006). The author hopes to return to Madagascar some day to learn whether the acceptance rate for latrines in Mahialambo proved high enough to measurably reduce water-borne disease levels. In addition, for Azafady to have been truly



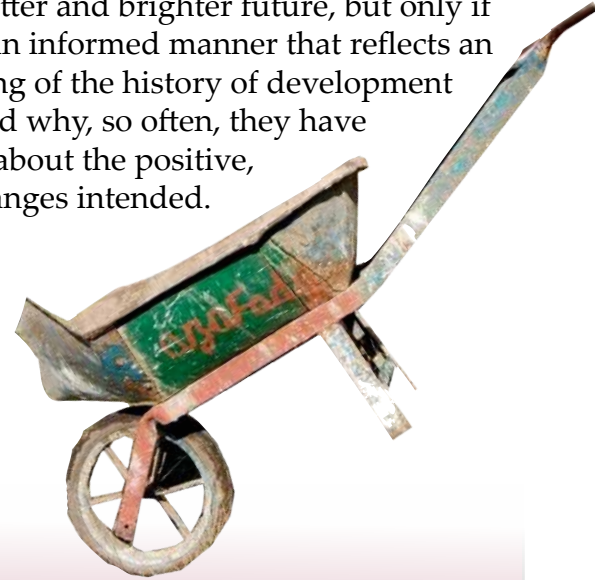
*Previously, only the children of wealthy families could attend the private Catholic school, however, with the inauguration of the new Azafady-built school, those children whose families could not afford school are now able to attend.*



effective, it would be important to determine whether the new stoves sufficiently reduced the firewood needed for cooking to noticeably increase women's ability to engage in additional income-earning activities or improve school attendance rates among children from families using the new stoves. Finally, any unanticipated consequences of the new technology would be important to understand in order to know if Azafady's approach could effectively be applied in nearby villages. Were latrines or stoves abandoned when they reached a state of

disrepair? Has deforestation slowed or simply leveled off? Is population increase offsetting any reduction in firewood gathered due to the new stoves?

With each small step, we continue to move closer to a better and brighter future, but only if we do so in an informed manner that reflects an understanding of the history of development initiatives and why, so often, they have not brought about the positive, longterm changes intended.



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## AUTHOR BIO

Taylor Foshee is majoring in Political Science and Environmental Studies. Taylor is an Elon College Fellow and recipient of the 2009 Lumen Prize. Her undergraduate research explores the effects of governance and conflict on poverty and environmental stress in Sub-Saharan Africa. She traveled to Madagascar in the summer of 2010 to work for Azafady and plans to return to East Africa to continue work for a non-governmental organization upon graduation.



*Pisces: Serranidae*

*Photo from [www.scenicreflections.com](http://www.scenicreflections.com)*

# GROUPE FISHERIES

## *A Population Survey, and an Enhancement of Juvenile Habitat in the Turks and Caicos Islands*

By Chelsie Whitaker Wagner

### ABSTRACT

Large grouper species have biological and behavioral characteristics that increase their vulnerability to overfishing. In the Turks & Caicos Islands (TCI), the exploitation of large groupers represents one of the most recent and rapidly developing fin fisheries. To establish a sustainable fishery, management policies must be based on an understanding of population sizes, distributions, and recruitment patterns, and means of enhancing the fishery need to be explored. The grouper populations at depths of 18 and 25 m around South Caicos were surveyed via extended belt transects. The sizes of groupers observed at 18m were not correlated with distance from nursery habitat, although areas of high density were identified and found to be mutually exclusive for Nassau grouper (*Epinephelus striatus*) and red hind (*Epinephelus guttatus*) juveniles. In an attempt to enhance the fishery, empty queen conch shells were placed in four seagrass plots > 300 m away from each other on the east coast of South Caicos in February 2008 (four 20m transects per plot, 20 shells added to each transect, 1 to 3 m depth). In April and July the densities of *E. striatus* and all other fish species were observed along manipulated and control transects; manipulated plots had significantly higher densities ( $p < 0.001$ ). These

findings suggest that empty queen conch shells, discarded as a waste product of the conch fishery in the TCI, may represent a simple and inexpensive way to enhance juvenile grouper settlement and survival.

### BACKGROUND

In the spring of 2008, the author had the opportunity to study abroad in South Caicos with a School for Field Studies (SFS) program through Boston University that is based out of the Center for Marine Resource Studies, CMRS (SFS 2008). A main focus of the CMRS is to work with the local community and government of South Caicos to help determine effective marine resource management strategies considering developing tourism (SFS 2008, 2009). The research completed at the CMRS has three main areas: the assessment and monitoring of marine resources, the conservation and managing of marine resources, and the assessment of socio-economic conditions (SFS 2009). Working with Dr. Claydon, graduate student Siri Jacob, and five other undergraduate students, the author spent the majority of everyday in April 2008 in the water collecting a wide variety of data focused mainly on the local grouper populations. In late May the author returned to South Caicos for an additional two weeks to work with Dr. Claydon.



Many small developing islands have limited conventional natural resources such as freshwater, forests, mineral commodities, and arable land. Consequently, many of these small island nations have large trade deficits. With limited economic options these nations frequently turn to the ocean surrounding them to exploit marine resources both for fishery and tourism industries. The Turks and Caicos Islands (TCI) in the Western Atlantic are relatively new to tourism and still adjusting to the related strains on their natural resources.

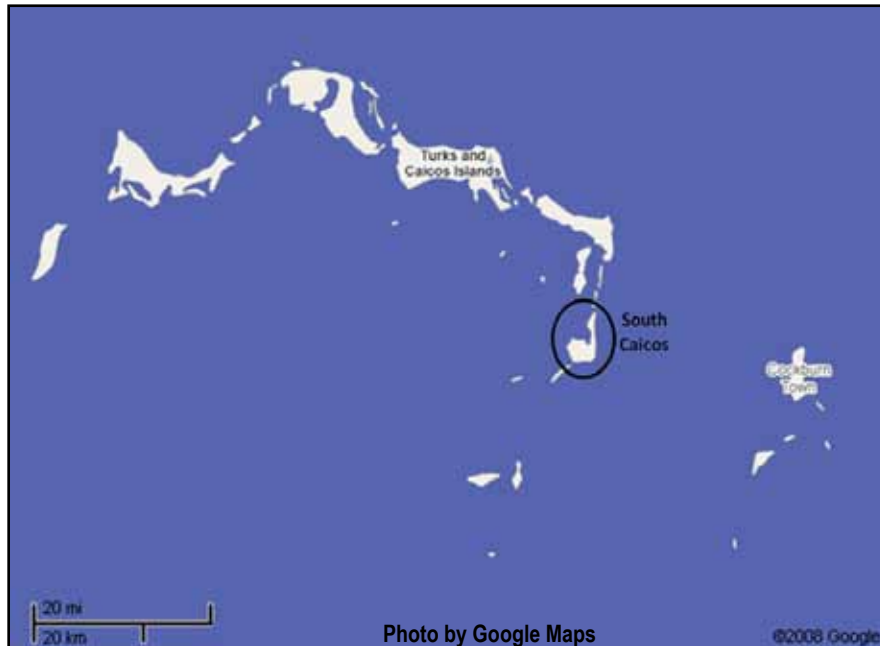
In the late 1700s, the American Revolution Loyalists immigrated with their slaves to the TCI (SFS

2008). When their attempts to farm the land yielded little success, the Loyalists returned to Britain leaving their slaves in the islands. Today the TCI remain under the British flag and the descendants of the abandoned slaves are known as the “belongers.” Though the islands were not productive as farms, the arid environment and presence of low, flat areas made them ideal for salt production via sea water evaporation from ponds called salinas. In the 1900s, the development of more efficient sources of salt production changed the market and in the mid 1960s salt production was discontinued in the TCI. Currently the TCI economy, like many other island nations, is largely dependent on its marine resources: both their extractive values in fisheries and non extractive values as a main attraction for tourists (SFS 2008, 2009). The TCI are known for their diving because of the relatively high quality of their marine resources, reef ledges that drop off to depths exceeding 2,500 m, and underwater visibility frequently greater than 30 m (SFS 2008).

The current population of the TCI including “belongers,” people from other Caribbean island countries, permanent vacationers, and temporary workers from all over the world is around 30,000; however an additional 200,000 people visit the islands annually (SFS 2008, 2009).

Around the TCI, there are far-reaching banks at about a 3-18 m depth that support extensive queen conch and spiny lobster fisheries (SFS 2008).

The center of these fisheries is Cockburn Harbour on the island of South Caicos where there are three processing plants that export large quantities of conch and lobster to local islands and the USA. The population of



*Above: Map of Turks and Caicos Islands with South Caicos circled.*

South Caicos varies from about 1000 to 1200 due to the emigration of fishers to the island during the lobster season. The island is about 31 km<sup>2</sup>; traveling by foot is generally reasonable though many people have trucks or cars. At the time of the author’s visit there were two gas stations, one clinic, one bank that is only open one morning a week, a few small stores with grocery and household items, and one functional hotel that rents an average of two rooms a month for three-four nights each. Islanders rely mainly on government jobs, small family owned businesses, or the extraction of marine resources for their livelihood (SFS 2009).

It is a time of change for South Caicos as the development of infrastructure for a tourism industry has been rapidly increasing. The construction projects of two large-scale tourist

developments are nearing completion, an international terminal is being built at the airport, and there is a proposal to dredge a deep water port (SFS 2008, 2009; TCInvest 2004). It is a critical time for many of the marine resources as the increased flux of people on the island will strain natural resources, the construction results in increased sediment and pollutants in the water, and development plans directly alter marine environments such as the dredging of seagrass beds in bays to produce the beaches many tourists desire (SFS 2009).

Current grouper landings in South Caicos are mainly bycatch, non-targeted species captured unintentionally, through the conch and lobster fisheries, but as tourism grows on the island and in the greater TCI region, large reef fishes such as grouper are becoming a sought-after resource. To ensure these large reef fishes are not overfished, it is essential that an effective fishery management plan based on knowledge of the biology, behavior, and population structure of targeted species be designed before a large-scale fishery is established.

## VULNERABILITY AND VALUE OF GROUPER SPECIES

Biological and behavioral characteristics of certain fish species can increase their vulnerability to being overfished. These characteristics include growth and maturity rates, sexual behaviors, and aggregation and migration patterns. Grouper (Pisces: Serranidae) fisheries generally pursue larger species such as yellowfin grouper (*Mycteroperca venenosa*), tiger grouper (*Mycteroperca tigris*), Nassau grouper (*Epinephelus striatus*), red hind (*Epinephelus guttatus*), and rock hind (*Epinephelus adscensionis*). There are also smaller, less sought after species of grouper such as the coney (*Cephalopholis fulva*) and graysby (*Cephalopholis cruentatus*). The separation of grouper



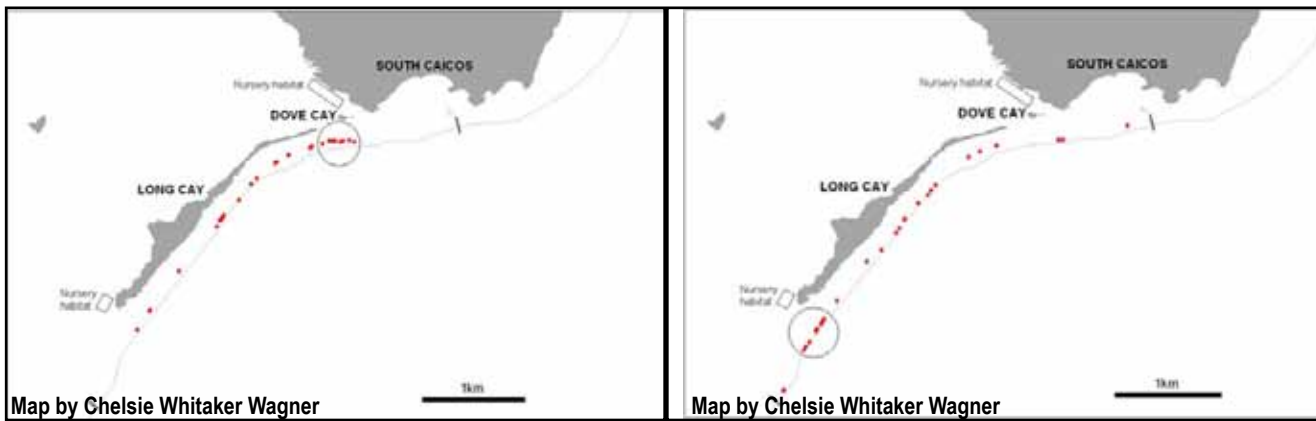
Photo by Chelsie Whitaker Wagner

Above: Nassau Grouper (*E. Striatus*)

species into different size ranges is important as the differently sized species have different biological characteristics and commercial values (Chiappone et al. 2000). The larger, more commercially desirable grouper species have various biological characteristics that make them particularly vulnerable to overfishing (Tupper 2000, 2002).

The general mechanics of overfishing start when the success of one fisher draws the attention of other fishers. Larger numbers of fishers lead to a decline in the fish population and consequently a decrease in the catch per unit of effort (CPUE). The fishers improve their techniques temporally, spatially, and technologically to bring their CPUE back to a ratio that is sufficient to support their livelihood. This positive feedback loop produces continually increasing fishing pressure that can lead to the disappearance of the fishery. As a result, the industry collapses, the resilience of the fish population to natural threats is compromised, the biodiversity and structure of the related ecosystems changes, and the fishery requires extensive time to recover (e.g. 1972 collapse of Peruvian anchovy fishery). The basic concept behind a sustainable fishery is simple: collect on the interest of the system not the capital (Robèrt 2002). This means fishers must harvest below the maximum sustainable yield so that the reproductive capacity of the population is not degraded. The successful application of this concept is dependent on proactive management that considers social, economical, and ecological parameters





The distribution of *E. striatus* (Above Left) and *E. guttatus* (Above Right) less than 31 cm TL observed within a 5 m wide transect surveyed at 18 m over 9.1 km. The areas of highest density of *E. striatus* and *E. guttatus* are circled.

(Eggleston 1995, Rudd & Tupper 2002, Sobel & Dahlgren 2004).

Large species of grouper are slow growing and reach sexual maturity at relatively large lengths (Sadovy & Eklund 1999, Coleman et al. 2001). Fish that have slow growth rates and are late to mature are particularly susceptible to being overfished as it takes a significant period of time to reestablish the adult population. *E. striatus* can live for over 29 years and take 4-8 years to reach sexual maturity at a size of 50-55 cm total length, TL (Sadovy & Eklund 1999). The average age of *E. striatus* at capture is between 2 and 9 years. The overlap between average age of maturity and capture means juvenile *E. striatus* are being fished.

While fishers apparently consider juvenile grouper large enough to be harvested, fishers tend to prefer larger individuals. The preferential fishing of larger individuals can be destructive to the fish stock because the size of the individual correlates with their contribution to the stock. For example, one 61 cm red snapper can produce the same number of eggs as two-hundred-twelve 42 cm red snapper (Coleman et al. 2001). Intense fishing pressure concentrated on the larger individuals can be further detrimental to many grouper species that make a sex change as they mature (Sadovy & Eklund 1999). For grouper species that are hermaphrodites, removing the larger individuals changes the male to female ratio in the population and can cause individuals to undergo sex changes prior to reaching sizes that make the sex change energetically beneficial. These

changes negatively impact the reproductive capacity of the population.

Characteristics of sexual behaviors such as temporal and spatial patterns can affect the vulnerability of a species to overfishing. Adult *E. striatus* are usually dispersed on offshore reefs at varying depths (Eggleston 1995). Around the time of a full moon in December or January, they migrate en masse (500 to 10,000 fish) sometimes covering distances over 100 km (Sale et al. 2005) to specific shallow reef locations (Aguilar-Perera et al. 2006) to form fish spawning aggregations, or FSAs (Colin 1992, Colin et al. 1997). This behavior limits the reproductive window of *E. striatus* to about ten days a year (Claro & Lindemann 2003). The highly predictive nature of FSAs, both temporally and spatially, makes them extremely vulnerable to fishing pressures (Sadovy & Eklund 1999, Coleman et al. 2001, Sala et al. 2001, Claro & Lindemann 2003, Aguilar-Perera et al. 2006). The migration routes to the spawning aggregations are also an issue of concern as exploiting them can greatly increase a fisher's CPUE thereby depleting the fishery with extreme efficiency.

Fishing pressure on FSAs is self-destructive to the fishery in a variety of ways. The population sex ratios can be altered, the abundance of mature fish decreased, and the average size of mature fish decreased (Sala et al. 2001). The removal of larger, older individuals is additionally problematic because grouper and other reef fish have strong site fidelity



Photo by Chelsie Whitaker Wagner

Above: Grassy Grouper

based on tradition (Warner 1988, Coleman et al. 2001). Therefore preferentially fishing larger and more experienced fish removes the individuals with the strongest capabilities to find FSA sites (Coleman et al. 2001). In many places FSAs have already been overfished to the point of collapse (Sadovy & Eklund 1999, Claro & Lindemann 2003, Aguilar-Perera et al. 2006); this includes areas from Cuba to the Greater Antilles where FSAs have almost completely disappeared (Sadovy & Eklund 1999). In the Caribbean it is estimated that one third of all grouper FSAs have disappeared (Sala et al. 2001). The grouper larvae produced during FSA events remain in open waters for 30-45 days covering distances around 70 km before settling, during this time the mortality rate is high (Eggleston 1995, Aguilar-Perera et al. 2006). While this does not directly impact vulnerability to fishing pressure, it does relate to the vulnerability of young of the year (YOY) to adverse short term weather conditions and climatic events.

Smaller grouper species can have life spans similar to large grouper species; however their maximum sizes and growth rates tend to be quite different (Araujo & Martins 2006). *C. fulva* can live for over 25 years though they only reach a TL of 45 cm. Around a TL of 16 cm, *C. fulva* become sexually mature females, and they undergo a sex change at 20 cm TL. Based on data from otolith (ear) sections, Araujo & Martins estimated that *C. fulva* grow very quickly early in life and more slowly in subsequent years (2006). The data suggest *C. fulva* can reach a TL of 27 cm within their first year. The spawning season of *C. fulva* can last up to 10 months, much longer than that of large grouper species. Even though some characteristics of small grouper species (e.g., sex changes) could potentially decrease resilience to fishing pressures, many characteristics such as fast growth rates and extended spawning seasons make small grouper species hardier than large grouper species with respect to fishing pressure.

Due to the ecological role of large grouper species as top predators on reefs (Sluka et al. 1997, Sadovy & Eklund 1999), the effects of overfishing can be broad reaching throughout the ecosystem (Nagelkerken 1981). Larger grouper species have been found to be more abundant in areas with minimal or no fishing pressure. However, in regions with intense fishing pressure the smaller non targeted grouper species have been found to be more abundant (Chiappone et al. 2000). This represents a classic response to intense fishing in which the community composition shifts from being dominated by larger species and individuals to smaller ones. Large grouper species impact the reef community by preying on various types of fishes and invertebrates (Sadovy & Eklund 1999). *E. striatus* can reach lengths over 85 cm, weigh more than 20 kg (Eggleston 1995), and live for over three decades (Sadovy & Eklund 1999). Removing large individuals not only impacts the species' population by decreasing reproductive capacity, it can impact other grouper species and change predator-prey relationships on the reef.



## RECOMMENDATIONS FOR THE GROUPER FISHERY

Large grouper species are biologically, socially, and economically valuable. An example of their biological value is the substantial role that *E. striatus* plays in coral reef communities as a top-level predator by feeding on fish and crustaceans (Sobel & Dahlgren 2004). Large grouper species are valuable to local communities directly as a protein source and indirectly due to the integral role fishing plays in their cultures (Rudd 2003). Economically, large grouper have significant value as an extractive and a non-extractive resource. In the Caribbean, large groupers are one of the most important commercial and recreational fishing resources (Eggleston 1995, Dahlgren & Eggleston 2000, Claro & Lindemann 2003). As a non extractive resource, large grouper species are important to ecotourism and dive industries (Sala et al. 2001, Rudd & Tupper 2002, Rudd 2003).

A study by Sala et al. compared the extractive vs. non-extractive economic value of *E. striatus* (2001). The extractive value

was determined using the Schaefer model, optimistic projections of the grouper landings, and assumptions that large grouper species populations are more resilient than they are known to be. The non-extractive value was calculated using conservative estimates of the profit that would come from an ecotourism based dive industry. This relatively simple economic model presented the annual non extractive value of groupers as more than twenty times the annual extractive value. The model also predicted that a fishery extracting numbers or proportions of the population similar to those recorded in recent years would be economically extinct in less than ten years while ecotourism would be a sustainable industry. Even if the estimates used are not completely accurate, the non extractive value of large groupers is considerable to say the least.

While theoretically it appears clear that grouper should be pursued mainly in a non-extractive manor, realistically intense fishing pressure and ineffective regulations of the past few decades, have led to dramatic declines in Caribbean grouper populations (Tupper 2000). *E. striatus* is considered economically extinct in various places including the U.S. Virgin Islands, Mexico, Belize, Florida, the Dominican Republic, Cayman Islands, and Puerto Rico (Sadovy & Eklund 1999, Chiappone et al. 2000, Sala et al. 2001). It is federally protected in the U.S. (Sala et al. 2001) and has been on the International Union for the Conservation of Nature's "red list" as an "endangered species" since 1996 (Cornish & Eklund 2003). The American Fisheries Society lists *E. striatus* as threatened (Sala et al. 2001) and suggests that fishing mortality should be maintained near the natural mortality, which for groupers is very low (Coleman et al. 2001).



Photo by Chelsie Whitaker Wagner

Above: Nassau Grouper

## SURVEY OF POPULATIONS AROUND LONG CAY



Currently, grouper densities are considered to be relatively high in the TCI (Claydon et al. 2008); however, recent increases in tourism are intensifying the pressure on this valuable marine resource. To develop an effective management plan focused on enabling a sustainable grouper fishery without compromising the potential value of ecotourism, the size, distribution, seasonal migration, and migration patterns relative to developmental stages (ontogenetic movements) of the local grouper population need to be better understood. In the spring and summer of 2008, a population survey looking at the general abundance, size structure, and distribution of groupers around South Caicos and Long Cay was completed by Dr. John Claydon, intern Siri Jacob, Chelsie Wagner, and five other undergraduate students.

For many reef fish, each life history stage is associated with specific recruitment dynamics and habitat types (Coleman et al. 2001). The early ontogenetic stages of grouper are fairly well understood including the settlement of larvae and movement of early juveniles. *E. striatus* have been found to settle in macroalgal clumps and macroalgal covered coral with a direct positive correlation between algal cover and grouper density (Eggleston 1995, Dahlgren & Eggleston 2000). Early *E. striatus* juveniles have an average growth rate around 1 cm a month; when they are about 5 cm TL they shift habitats to just outside of or adjacent to macroalgal-covered areas. Juvenile *E. striatus* make an ontogenetic habitat shift to natural or artificial patch reefs when larger than 15 cm TL and eventually shift to deeper offshore adult habitats (Eggleston

1995, Dahlgren & Eggleston 2000, Coleman et al. 2001, Aguilar-Perera et al. 2006). Adult groupers are generally sedentary and live near holes, caves, and crevices at depths up to 300 m (Chiappone et al. 2000). These spatial distributions and ontogenetic movements are influenced greatly by size-dependent factors such as changing mortality risks and growth rates (Eggleston 1995, Dahlgren & Eggleston 2001).

While many reef fish population studies have been performed, the use of distribution to focus on ontogenetic movements is relatively new for studies specific to groupers and so far appears to be restricted to early juvenile ontogenetic movements. The waters along South Caicos and Long Cay present a unique situation where the cay acts as a 5 km physical barrier to fish movement. With known nursery and juvenile habitat on one side of the cay and deep coral reef adult habitat on the other side (Claydon & Kroetz 2007), this physical barrier ensures that juveniles of species that utilize nursery habitat must come from either end of Long Cay to reach adult habitat. The physical separation of juvenile and adult habitat facilitates the analysis of grouper size distributions relative to distances from nursery habitat. Also this area is protected from fishing as it is a part of the Admiral Cockburn Land and Sea National Park.

The expected pattern is that increased distances from nursery habitats will correlate with increased mean size for species that require nursery habitat, *E. striatus*, *M. tigris*, *M. venenosa*, *E. guttatus*, and *E. adscensionis* (Eggleston 1995, Nadeau & Eggleston 1996). This would imply that the nursery habitats act as a source of juveniles for the adult habitat, and individuals continue to move away from nursery habitats as they grow and develop. A similar pattern is not expected for species that are able to settle directly onto adult habitat, *C. fulva* and *C. cruentatus* (Trott 2006). Results showing a random distribution of these species along the coast of Long Cay would support the expected recruitment scheme for these species.



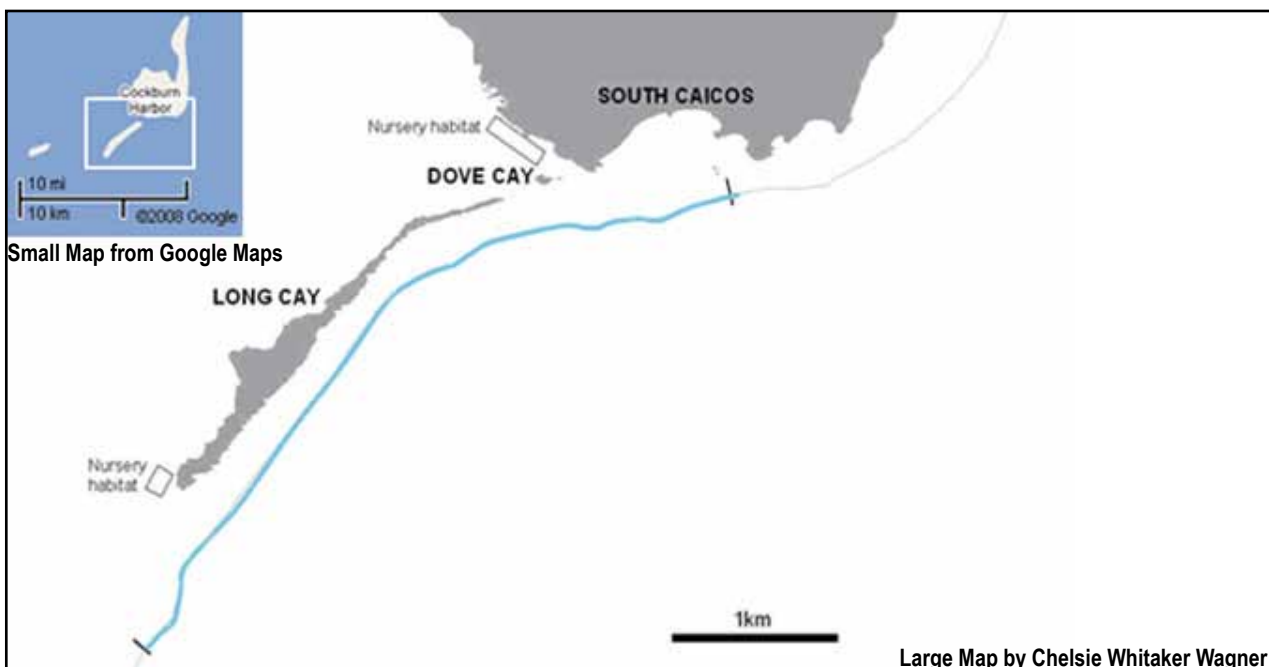
## POPULATION SURVEY METHODS

As grouper species can be cryptic, change coloration, and behave elusively (Sadovy & Eklund 1999, Tupper 2000), all observers were extensively trained to identify species of grouper including *C. cruentatus*, *C. fulva*, *M. tigris*, *M. venenosa*, *E. adscensionis*, *E. guttatus*, and *E. striatus*. The observers were trained to estimate the size of fish underwater by practicing with model fish (TL: 3 to 85 cm). When tested with 20 model fish, the estimates of the six observers differed from the actual sizes by an average of 2.27 cm (standard error = 0.202). The observers were also trained to estimate a 5 m belt width using 5 m ropes underwater.

The abundance and distribution of grouper along the eastern shore of Long Cay bordering the Turks Island Passage was surveyed by performing an extended belt transect using SCUBA. A 9.1 km transect at a depth of 18 m was completed over six days between the 16th and 25th of April 2008. The reef area surveyed runs parallel to Long Cay for 5 km, and extends past the northern and southern ends of the cay. The transect followed the reef topography and covered a total area of 45,625 m<sup>2</sup>. Over the course of June, July, and August 2008, a parallel transect was performed at a depth of 25 m. The species and size of every grouper observed was recorded

along these two 5 m wide transects. The distribution of grouper was analyzed by determining abundances, size ranges, and average sizes for all species observed. The size distribution of each species population was graphed.

The time of each grouper sighting was recorded and later used to determine the location of observed individuals based on the track of a GPS unit that was being towed by the observers at the surface. The time of sighting for each observed grouper was connected to the spot along the GPS track with the same time. In this way, the locations of observed groupers were mapped using Trip & Waypoint Manager Garmin software. The relationships between population distributions and geographical features were analyzed. This map was also used to determine the distances of individuals from areas of known nursery habitat for those individuals observed within the 5 km portion of the transect that ran along Long Cay. To check for patterns in size distribution suggestive of ontogenetic movements, a linear regression (SigmaStat 3.1) was performed on the size of these individuals and their distance from juvenile habitat.



Above: Map of Long Cay and the southern coast of South Caicos. Known grouper nursery habitat is labeled, the blue line traces two 9 km long transects done at depths of 18 and 25 m.

## POPULATION SURVEY RESULTS

Over the entire 18 km of reef surveyed, 1279 individual groupers were observed: 790 at 18 m and 489 at 25 m. Seven grouper species were observed: *C. cruentatus*, *C. fulva*, *M. tigris*, *M. venenosa*, *E. adscensionis*, *E. guttatus*, and *E. striatus*. The number of individuals of large grouper species observed in this survey offers a glimpse at the sizes of these commercially important grouper populations. Three of the larger grouper species, *M. tigris* (n=27), *M. venenosa* (n=17), and *E. adscensionis* (n=1), were observed in very low numbers making it difficult to further analyze their population size structures. Two large grouper species, *E. striatus* and *E. guttatus*, had more substantial abundances. While a relatively large number of *E. striatus* (n=222) were observed, less than 30 percent of *E. striatus* were large enough to be sexually mature (TL > 50 cm). The abundance of individuals varied greatly between species with large numbers of small grouper species that are not currently exploited commercially, *C. fulva* (n=790) and *C. cruentatus* (n=90), being observed.

The results provide a basic understanding of grouper populations' size structures around the southern coast of South Caicos. The size distributions of the smaller grouper species, *C. cruentatus* and *C. fulva*, appeared to follow normal distributions including individuals in size classes representative of YOY, TL < 12 cm (Humann & Deloach 2002). The observed sizes of large grouper species, *E. guttatus* and *E. striatus*, appeared to follow a relatively normal distribution;

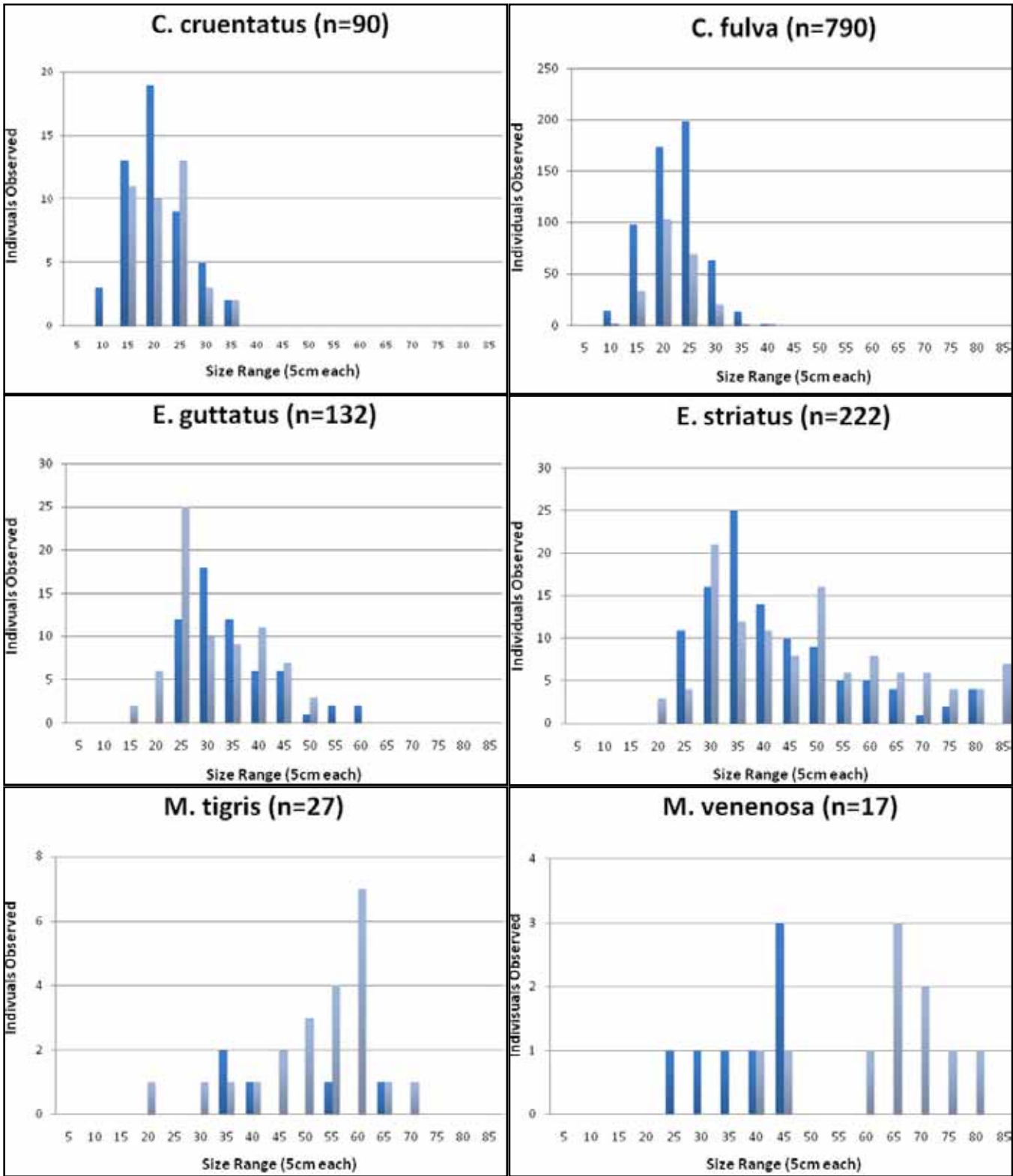
however, no individuals were seen in the smaller size classes (TL < 21 cm at 18 m; TL < 15 cm at 25 m).

The depth and substratum surveyed are generally considered grouper adult habitat (Thompson & Munro 1978, Eggleston 1995, Tupper 2002); these results indicate the settlement of small grouper species directly on adult habitat (Trott 2006) and the inability of large grouper species to settle on adult habitat (Eggleston 1995; Nadeau & Eggleston 1996). This supports the importance of protecting nursery habitat for the settlement of large grouper species. The size structure distributions of *E. striatus* and *E. guttatus* both appear to be slightly skewed to the right, *E. striatus* more dramatically than *E. guttatus*. This can most likely be explained by decreases in natural mortality that correspond with increases in individual size (Dahlgren & Eggleston 2000).

For all of the three species for which linear regressions were run, *C. cruentatus*, *E. striatus*, and *E. guttatus*, no correlation was found between individual size and distance from one of two known nursery habitats at a depth of 18 m. This was expected for small grouper species such as *C. cruentatus* as the ability to settle directly into adult habitat makes the distance from an area generally considered nursery habitat irrelevant. Conversely, for *E. striatus*, *E. guttatus*, and other grouper species that require nursery habitat, a positive correlation between increasing distance from nursery habitat and size of individuals was expected. Instead, the results of this study support the possibility of larger or more variable ontogenetic intervals than expected.

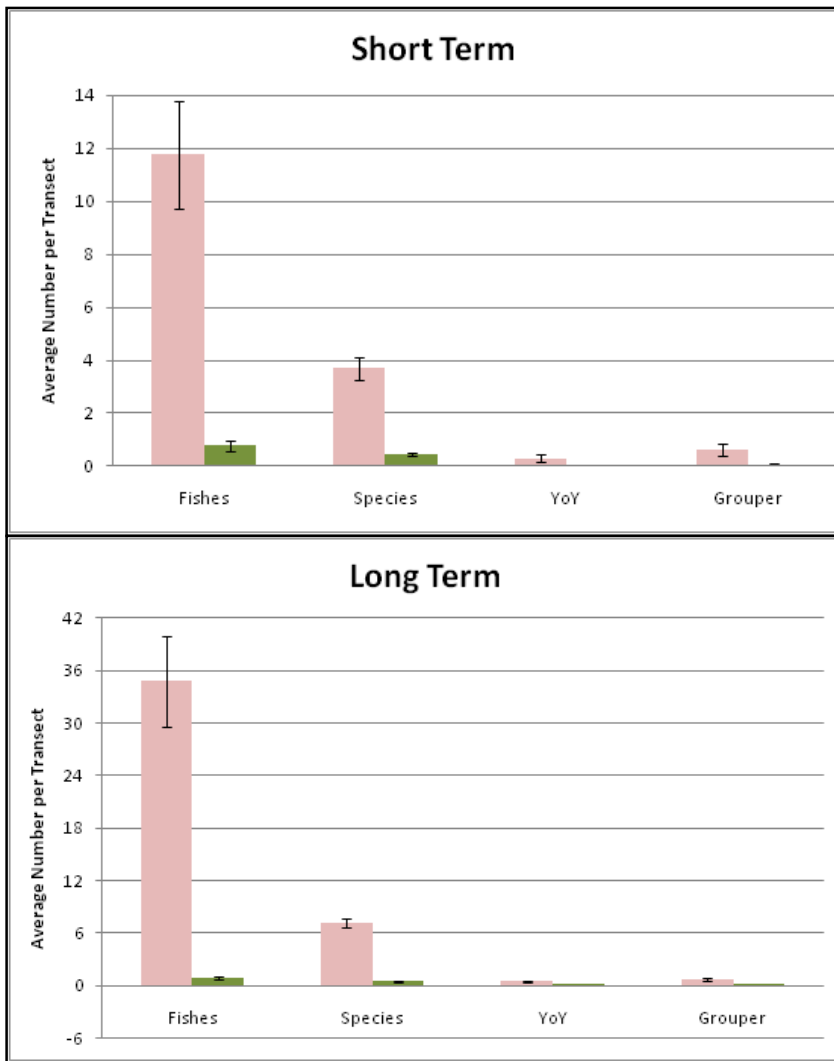






All Graphs by Chelsie Whitaker Wagner

The size distribution of 6 grouper species (*C. cruentatus*, *C. fulva*, *M. tigris*, *M. venenosa*, *E. guttatus*, and *E. striatus*) observed in a survey of reef at 18 and 25 m along the coast of Long Cay.



All Graphs by Chelsie Whitaker Wagner

*The average number of fishes, species, E. striatus YOY, and grouper observed in treatment sites (n = 16) and control sites (n = 72) for data collected 3 and 7 months (April and August 2008) after conch shells were added to seagrass habitat. Standard error bars are included.*

## DISCUSSION OF POPULATION SURVEY

There are a few factors that may help explain why juvenile *E. striatus* and *E. guttatus* were found to migrate along adult habitat at different rates than anticipated. The SCUBA transects followed the reef at the depths specified and therefore were not perfectly straight lines. Along these paths different dips and contours were encountered as well as areas of low and high environmental complexity. Considering these factors, perhaps larger juvenile and young adults swim until they find unoccupied and suitable habitat. An

individual with a suitable habitat may have no reason to continue moving along adult habitat. Conversely, if many places are already occupied, an individual may move further along the habitat to find an ideal location. These potential explanations support the variations in the distance of a large juvenile's ontogenetic movement onto and across the adult habitat seen in the results.

Although the results do not support the originally hypothesized linear trend in the size distribution of grouper from nursery habitats, discontinuities were still observed for the distribution of groupers with TL less than 31 cm. For small grouper species, a TL less than 31 cm describes all but the largest adults. The lowest *C. cruentatus* density for individuals of the described size range was observed around and to the south of the southern end of Long Cay. This is most likely due to a decrease in the complexity of the habitat in this area as *C.*

*cruentatus* were usually observed hiding in holes and crevices within coral structures. The peak *C. cruentatus* density occurred in areas along Long Cay probably due to the high complexity of the reef habitat in this area that is sheltered by Long Cay. *C. fulva* were observed with relatively a high and consistent frequency. There was not a specific area with notable peak in *C. fulva* density. For large grouper species, the size range being considered (TL < 31 cm) describes only juveniles. The area with the highest density of *E. striatus*, seven times greater than the rest of the areas surveyed, was south of the channel that runs between Dove Cay and northern end of Long Cay. *E. guttatus* of the described





Photo by Chelsie Whitaker Wagner

*Above: Image of divers recording species and size data along a belt transect.*

size range was observed in high density, over six times greater than the rest of the areas surveyed, south of the southern end of Long Cay.

Both *E. guttatus* and *E. striatus*, were observed to have an area with relatively high density compared to the rest of the transect. Interestingly, these concentrated areas were mutually exclusive with the exception that one *E. striatus* was observed in the area with the highest density of *E. guttatus*. This exclusivity is most likely due to differences in preferred nursery habitat as the area with high *E. striatus* density was close to the northern nursery habitat while the area with high *E. guttatus* density was close to the southern nursery habitat. The northern nursery habitat is within the channel that runs between Dove and Long Cay and includes more seagrass and blowout habitat than the southern nursery habitat which has larger areas of patch coral habitat (Claydon & Kroetz 2007). While the mutual exclusiveness of these areas of high density could also be due to interspecies competition, this is less likely as individuals (TL < 31 cm) of both species were observed together along other portions of the transect.

Trends were also found when considering the areas where *E. striatus* and *E. guttatus* with TL less than 31 cm were not observed. These areas included those near the furthest

boundaries of the extended transect in regions where the distance to closest shoreline appears to be the greatest. In the most southern km of the transect, from the end of Long Cay, only three *E. guttatus* were observed and no *E. striatus*. The first 500 m extending from the northern boundary of the transect comes somewhat close to the shoreline of South Caicos, one *E. guttatus* (TL ≤ 30 cm) was observed in this area. The next km of the transect is adjacent to East Bay of South Caicos. Over this area where the transect is further from the shoreline but at the same depth, no *E. guttatus* or *E. striatus* were observed. This trend in the low densities of *E. striatus* and *E. guttatus* in these areas with seemingly greater distances from shorelines is intriguing and may be an artifact of the distance from shore, habitat complexity, or oceanographic conditions. The results of this population survey provide information that is critical in determining the population structure of grouper around the TCI and extrapolating an estimate of the existing potential for fisheries.

Given what is known about the vulnerabilities of large grouper species to overfishing and the population size observed during the described surveys of the South Caicos grouper population, it appears that a large commercial fishery is not sustainable. However consideration of the role fishing plays in the livelihood of many South Caicos inhabitants and the growth of the tourism industry in the TCI makes the reality of increasing pressures on marine resources like large grouper evident. Methods promoted for exploiting large grouper should include subsistence fishing, a small scale fishery to supply local restaurants, sports fishing, and dive tourism. To potentially make the expected expansions in large grouper exploitation sustainable, ways to enhance the fishery need to be explored.

## POTENTIAL ENHANCEMENT OF THE JUVENILE HABITAT

Fish spawning aggregations (FSAs) and a pelagic larval existence are two of the aspects of large grouper species' life cycles that have high vulnerability. While these life features significantly impact and limit settlement, manipulating them to enhance reproductive output is largely unfeasible. Adult *E. striatus* have very low natural mortality as they are a top predator on the reef (Coleman et al. 2001); however small juveniles, whose survival ultimately impacts the abundance of adults, are vulnerable to predation (Aburto-Oropeza et al. 2007, Claro & Lindemann 2003). The results of one study on the reef fish *Halichoeres* support the substantial impact early post-settlement predation can have on local population sizes and suggests that high post-settlement mortality can prevent the establishment of an adult population (Carr & Hixon 1995).

Grouper larvae settle in nearshore nursery habitats such as macroalgae-covered substratum, seagrass beds, and mangroves (Sadovy & Eklund 1999). However some studies have not found juvenile *E. striatus* in seagrass habitats (Eggleston 1995) and others have noted substantially higher numbers of early juveniles in macroalgae than seagrass (Nadeau & Eggleston 1996). Shortly after

settlement of pelagic juveniles, benthic *E. striatus* juveniles have been found on artificial reef structures such as conch shells, natural reefs, and rubble mounds (Colin et al. 1997). In monthly censuses of *E. striatus*, one study almost exclusively observed juveniles in rare complex microhabitats such as holes or ledges in the natural substratum, cinderblocks, and other rubble (Dahlgren & Eggleston 2001).

Predation is influenced by a few different factors; the one with the greatest potential for manipulation is shelter. Generally, a positive relationship exists between habitat complexity and fish density. In the spring and summer of 2008, Dr. John Claydon, intern Siri Jacob, Chelsie Wagner, and Ryan Stuart studied a manipulation of the structural complexity



*Above: Image of a section of a 20 m long transect to which 20 conch shells were added.*

of seagrass beds to observe any potential enhancement of the survivorship of early juvenile grouper. The nursery habitat adjacent to Long Beach that was manipulated consisted of seagrass, algae, and sand at depths ranging from 2-3 m.



## HABITAT ENHANCEMENT METHODS

The manipulation involved the placement of empty conch shells within this habitat in four discrete areas. In each area, four 20 m transects were set up with 10 empty conch shells firmly pressed into the seagrass bed and 10 attached to the bottom with steel bar poles that were pushed into the substratum. The conch shells were a meter apart and alternated free standing and anchored shells. The shells were spaced from one another as opposed to in piles because large grouper species juveniles are thought to be solitary (Dahlegren & Eggleston 2000). The shells were added during the week before the new moon on February 7, 2008 to correspond with the settlement time frame of grouper into seagrass beds (Eggleston 1995, Dahlegren & Eggleston 2000, Coleman et al. 2001). The four areas were at least 300 m from each other and about 10 m from shore. The conch shells, collected from large piles on Long Cay, were free of conch tissue, epiphytes, and invertebrates.

On April 24, June 3, July 3, August 7, and September 12, 2008, the effects of the manipulation on juvenile grouper were monitored by snorkeling each of the 20 m conch shell enhanced transects (transect average of 19.9 conch shells) and various control transects (transect average of less than 0.6 conch shells). The size and species of all grouper, the number and species of all other fishes, and the number of empty conch shells observed in each transect were recorded. The control transects were intentionally placed at a few different distances (50, 100, & 150 m) from treatment sites to check for enhancement of the habitat as opposed to attraction of fish to the manipulated habitat from nearby areas. No difference was found in the

number of fishes, species richness, *E. striatus* YOY, *E. striatus*, or grouper between the control sites at varying distances from the treatment sites.

This supports the enhancement theory for any differences found in these numbers between control and treatment sites. If instead the data had shown a trend where fewer grouper were observed in control sites close to the treatment sites than in those further away, this would have suggested that the manipulation was drawing grouper that would have otherwise settled in the control areas instead of increasing the overall number of grouper in the seagrass bed.

## HABITAT ENHANCEMENT RESULTS

Three months after the addition of 320 empty conch shells in February 2008 to 16 transects covering a total of 320 m<sup>2</sup>, a total of 319 conch shells were observed. Both of the conch placement techniques seemed relatively stable and effective as despite various small weather patterns over the course of the next four months,



Photo by Chelsie Whitaker Wagner

Above: Juvenile grouper (*E. striatus*) found utilizing the shelter of the conch shells that were added to seagrass beds.

319 shells were still present at the manipulated sites in August 2008. However after the area suffered a direct hit from Hurricane Ike in September 2008, only 51 of the original 320 added shells were observed in the manipulated sites. Regardless of the placement technique used, the manipulation of a seagrass bed via the addition of conch shells appears to have a threshold level for the amount of turbulence it can endure.

Separately considering the short term (April, 3 months) and long term (August, 7 months) data, the addition of rows of evenly spaced empty conch shells significantly increased the number of fishes, species, groupers, *E. striatus*, and *E. striatus* YOY observed in seagrass beds ( $p < 0.001$ ). The species observed utilizing the conch shells included *E. striatus*, *Panulirus argus* (spiny lobster), and *Chaetodon striatus* (striped butterfly fish). In April, the average number of fish individuals observed per control transect was less than one from an average of 0.45 species. The average number of fish individuals per manipulated transect was around 12 from an average of 3.7 species. The average number of grouper individuals per manipulated transect, 0.625, was about ten times greater than the number of grouper individuals per control transect. No *E. striatus* YOY were observed in control transects. A total of 5 *E. striatus* YOY were observed over the 319 conch shells distributed across 16 manipulated transects.

In August, the average number of fish individuals observed per control transect was still less than one from an average of 0.5 species. The average number of fish individuals per manipulation transect was about 35, three times greater than the amount observed in April. These fish

individuals observed in manipulated areas were from an average of 7.1 species per transect, about double what was observed in April. The average number of grouper observed per

manipulated transect, 0.688, was about the same as in April. In August an average of 0.01 grouper were observed per control transect. In the data from both June and July, there were 10 *E. striatus* YOY utilizing the manipulated transects. In August, 8 *E. striatus* YOY were observed for the 319 added conch shells, and 1 *E. striatus* YOY over the 8 conch shells found in the 72 control transects.

## DISCUSSION OF HABITAT ENHANCEMENT

The average number of species and fishes observed per manipulated transect did increase notably from April to August. As the amount of species and fishes observed per control transect did not show much variation between the data collected in April and August, these increases do not seem to be a seasonal effect. Instead, these increases over time suggest a possible long term effect. This is similar to patterns observed in previous studies where changes in the abundance of one species have cascading effects on the abundance of other species (Nagelkerken 1981, Chiappone et al. 2000). It is logical that the increased habitat complexity achieved by habitat manipulation draw in small, shelter-seeking, juvenile fish, the presence of which attracts other fish over time.

While some migration and ontogenetic movement of grouper may occur, no settlement of juvenile grouper between April and August was expected considering that large grouper species only spawn at annual SPAGS. This was supported by the results as the number of grouper observed per manipulated transect did not change substantially when comparing the short and long term data. Of the grouper observed, *E. striatus*, including a significant number of YOY, were the most common species. The numbers of grouper observed were fairly low considering the number of empty conch shells. Despite the low concentration of groupers, the enhancement was effective as the difference



between manipulated and control transects was significant.

The potential this manipulation technique exhibited to enhance the grouper fishery by increasing juvenile survival rates is of great importance. The numbers show that the addition of 320 shells to a 320 m<sup>2</sup> area was utilized by a range of 5-10 *E. striatus* YOY as shelter. Extrapolating from these numbers, manipulating a seagrass bed of a thousand m<sup>2</sup> could provide shelter for about 16 to 31

*E. striatus* YOY. A manipulation of 10,000 m<sup>2</sup> could increase the survival rates of 156 to 313 *E. striatus* YOY, and one covering 1 km<sup>2</sup> could help protect 15,625 to 31,250 *E. striatus* YOY. Around TCI, empty queen conch shells are a natural and abundant local resource commonly mass discarded by conch fishers (Rudd 2003). The local fishers historically and currently toss conch shells onto large piles that are usually along the shoreline. These piles offer a means of increasing structural complexity that is known to increase fish survival rates. Wilson et al. (2005) found that juvenile fishes preferred conch shell piles over sand, seagrass, and mangrove microhabitats, however only one juvenile grouper was observed. The results of the described manipulation indicate that discarding conch shells could serve as an important grouper and spiny lobster juvenile habitat enhancement if they were systematically dispersed throughout seagrass beds.

Early juvenile *E. striatus* shift from macroalgal-covered areas, to nearby habitats when they are about 5 cm TL, equivalent to about 4 or 5 months old (Eggleston 1995, Dahlgren & Eggleston 2000). This

corresponds to April as the expected time that *E. striatus* YOY migrated into manipulated sites. For any *E. striatus* YOY that may have settled directly into the shells, the 5 cm size reached around April should

have been large enough for visual observation.

Juvenile *E. striatus* make an ontogenetic habitat shift to patch reefs when they are about one year old (Eggleston 1995, Dahlgren & Eggleston 2000, Aguilar-Perera et al. 2006). This suggests that the *E. striatus* YOY would migrate

from the shells to reef habitat in December or January. Following the annual spawning and first year migration patterns of *E. striatus*, a habitat enhancement project with conch shells could potentially offer shelter to the *E. striatus* YOY of sequential years. Thus the return rate suggested by the results of this study of one *E. striatus* YOY per every 32 to 64 conch shells could potentially be an annual return rate.

Firm placement of empty conch shells, oriented with their open interior facing up, into a seagrass bottom with a spacing of approximately one shell per m<sup>2</sup> would match the dispersion pattern that was found to be ecologically successful. Ideally, areas that are not fished for conch could be set aside for empty conch shells to be discarded in this nontraditional fashion. This seems to be a low cost and environmentally friendly way to capitalize on the waste of the TCI conch fishery and potentially enhance grouper populations through increased local recruitment and survival rates of early juveniles. Of course implementation of this technique needs to be based on realistic considerations of social and economical



Photo by Chelsie Whitaker Wagner

*Above: Juvenile grouper (E. striatus) found utilizing the shelter of the conch shells that were added to seagrass beds.*

parameters that were not directly considered in the described study. Hopefully fishers would be interested in investing a bit of extra time to distribute empty conch shells in seagrass beds instead of in piles if they believed that it would increase the number of spiny lobster and grouper available.

## CONCLUSIONS

As tourism grows in the TCI, the marine resources face increasing stresses. As previously explained, an understanding of grouper biology depicts characteristics of large grouper species that add challenges to establishing and managing a grouper fishery. Most previous grouper fisheries have resulted in such substantial declines that *E. striatus*, a large grouper species, is considered economically extinct in many places and listed as an endangered species on the International Union for the Conservation of Nature's red list. The described population survey of the grouper species living on the coral reefs around South Caicos and Long Cay found high amounts of small grouper species. Some large species were observed in very low amounts while *E. striatus* and *E. guttatus* were observed with relatively high frequency. The spatial distribution of juvenile *E. striatus* and *E. guttatus* and landmass impact on larval and juvenile movement. Policy makers

need to consider exposed some interesting trends potentially relative to nursery habitat preferences the local population size and distribution when developing regulations that encourage job markets for the islanders that do not wipe out the grouper fishery.

Ideally, regulations should require TCI to pursue large groupers strictly as part of ecotourism. Consideration of the social, cultural, political, and economic roles the existing conch and lobster fisheries play in the communities of islands like South Caicos quickly depicts the reality that such regulations towards a developing fishery would likely be rejected. Instead policy makers would be wise to encourage ecotourism, sport fishing, and a well managed small scale fishery. Ideal regulations would include a network of reasonably sized marine protected areas, size restrictions (55 cm TL minimum and 85 cm TL maximum), intensively designed closed seasons to protect grouper during SPAGs, quotas, and innovative techniques such as the described habitat enhancement (Claydon et.al 2008). In addition to attempting to discover other methods of enhancing the fishery, the Center for Marine Resource Studies on South Caicos should continue surveying grouper populations to monitor the impact of the growing fishery and the success of management techniques.





## END NOTES

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Chelsie Wagner presented this research at NCUR and SURF in the spring of 2009. The seagrass manipulation data were presented at the 61st Gulf and Caribbean Fisheries Institute conference in November 2008; she was included as the third author. It will be published in the conference proceedings as *Juvenile habitat for Nassau grouper and spiny lobster is enhanced by discarded queen conch shells*.



Photo by Chelsie Whitaker Wagner

Above: Image of two divers and a GPS unit set into a red flotation device.

Photo Provided by Chelsie Whitaker Wagner



Above: Author Chelsie Whitaker Wagner diving

## AUTHOR BIO

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Chelsie W. Wagner graduated Magna Cum Laude from Elon University in 2009. She completed the research presented in this article under the guidance of the School for Field Studies's Dr. John Claydon and Elon University's Dr. Michael Kingston. After graduation, Chelsie worked as a science instructor in the Florida Keys before returning to the School for Field Studies's Center for Marine Resource Management where she continued working with Dr. Claydon as an intern. Currently, Chelsie is a graduate student at Florida State University's Marine Lab where she is working towards a Ph.D. in Ecology and Evolution under the guidance of Dr. Kevin Craig.

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# QUICK READS

## QUANTIFYING THE CARBON AND PESTICIDE FOOTPRINTS OF ELON UNIVERSITY'S DINING SERVICES

By Hunter Cavell, Devin Darrell, Katie Day, John Hitchcock, Lexi Kay, Kim Krumm, Mica McCullough, John McGreevy, and Jess Sikking

### ABSTRACT

*Elon University has pledged to work towards more environmentally friendly practices, including the goal of becoming carbon neutral by the year 2037. An Environmental Studies Senior Seminar class (2010) researched the carbon emissions from produce used in Elon Dining Services, concentrating on common pesticides found in fruits and vegetables. Students compared the findings to research done by the non-profit organization Clean Air-Cool Planet, finding significant differences in Elon's estimated overall carbon "foodprint" but similar findings for each individual produce item. Students recommend that Elon Dining Services use local and seasonal fruits and vegetables to reduce carbon emissions.*

Elon University has recently prioritized sustainability by assessing its current practices, researching and applying methods to reduce its environmental impact, and setting the goal of becoming carbon neutral by the year 2037. The university has conducted annual greenhouse gas (GHG) emission inventories since 2008, but an important variable missing from those calculations were the carbon and pesticide footprints of the food provided in university dining halls. The Environmental Studies Senior Seminar class of 2010 was asked to work with the non-profit organization, Clean Air-Cool Planet (CA-CP), as well as survey relevant literature to determine an estimate for Elon University's carbon footprint from campus food services, or its "foodprint."

The project had two goals: to calculate carbon emissions from the ten most frequently used produce items at Elon, and to research the

most common pesticides used on each of the ten produce items, as well as their health effects. The initial food usage information received from ARAMARK, Elon's food provider, included bell peppers, strawberries, carrots, grapes, celery, potatoes, lettuce, pears, apples, and

bananas. These are based on the Environmental Working Group's "Dirty Dozen" list, as well as ARAMARK's top four produce items purchased.

The carbon footprint for each commodity consisted of general farm practices mode of transportation, and the distance each commodity



English Professor Andy Angyal and sophomore Meredith Naughton of the Green Team Environmental Service learning organization prune apple trees. PHOTO BY Angie Lovelace



traveled to arrive at Elon. It is important to note that a full life-cycle analysis of the ten produce items was not completed. General farm practices consisted of tractor use, planting, irrigating, fertilizing and harvesting techniques used on the farms. The produce was typically shipped via refrigerated semi-truck, although some produce arrived from international locations as boat cargo. The amounts of each commodity and their place of origin were included in ARAMARK correspondence, and Google Maps was used to determine the distances from producer to warehouse to ARAMARK's Morrisville, NC distribution center to Elon.

The pesticide footprint for each commodity was compiled based on the information from the Pesticide Action Network's website, "What's On My Food." Every produce item was listed with the relevant pesticides and amount in which they occurred, in addition to the categorization of its health implications, such as "Known Carcinogen," "Neurotoxin," etc. Elon decided to examine only those pesticides that occurred with a frequency of greater than ten percent.

While the actual numbers of the carbon footprint estimate differed greatly, the highest and lowest carbon footprint items were found to be similar between the two studies. According to Elon, bananas had the highest carbon footprint, lettuce had the second highest and celery had the lowest. CA-CP did not examine bananas due to a lack of available information, but determined that lettuce was the most carbon-intensive. Overall, Elon's estimates (a combined total of 87.6 metric tons) were significantly lower than those of CA-CP (with a combined total of 21,955 metric tons). Transportation was found to be the sector in which the most carbon was emitted, especially through refrigerated transport. The discrepancies between the two studies are thought to occur because CA-CP accounted for refrigerated transportation emissions, while Elon did not have access to that information.

As far as pesticides were concerned, celery was the most pesticide-heavy (55), followed by lettuce (52), bell peppers (50), apples (42), strawberries (39), grapes (34), carrots (18), potatoes (17), and bananas (12). The majority of the chemicals used on these items were hormone disruptors, followed by carcinogens, neurotoxins, and

developmental and reproductive toxins (see Figure 1).

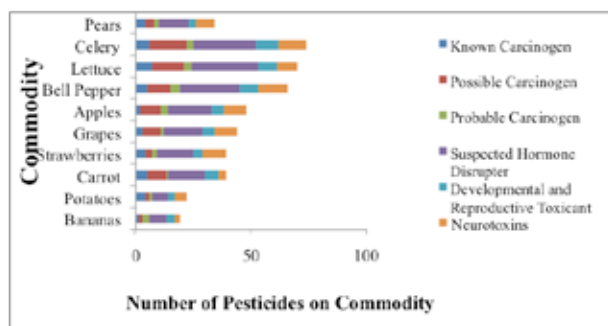


Figure 1: Number health effects of pesticide residues found on ten items.

Based on the relevant literature of carbon emissions and pesticide use, the project data conclude that the following, in descending order of priority, should be purchased from organic providers: apples, lettuce, strawberries, celery, bell peppers, pears, carrots, grapes and bananas. From the information gathered on potatoes, it is apparent that there would be no significant benefit to switching to organically grown varieties. Given the information gathered, purchasing locally grown produce may benefit Elon's goals to be carbon neutral by 2037 and to lower its ecological "foodprint" in reference to carbon emissions. The "foodprint" would be lessened further if organic food was purchased, which would reduce pesticide usage.

Purchasing seasonal fruits and vegetables within the region may reduce carbon emissions, however, this change may produce negative reactions from those who eat at on-campus dining facilities and prefer a wide variety of produce year-round. For this reason, before any such change occurs, the student paradigm must shift. If local foods are not an ideal option in terms of emissions, Elon might consider urging ARAMARK to develop closer relationships with more sustainability-minded vendors. A good resource for ARAMARK in North Carolina is the North Carolina Farm Stewardship Association (CFSA), which promotes sustainable agriculture by working with farmers and consumers.

Ultimately, the researchers recommend that Elon purchase local items when appropriate, and to further work with ARAMARK to increase the transparency of its supply chain.





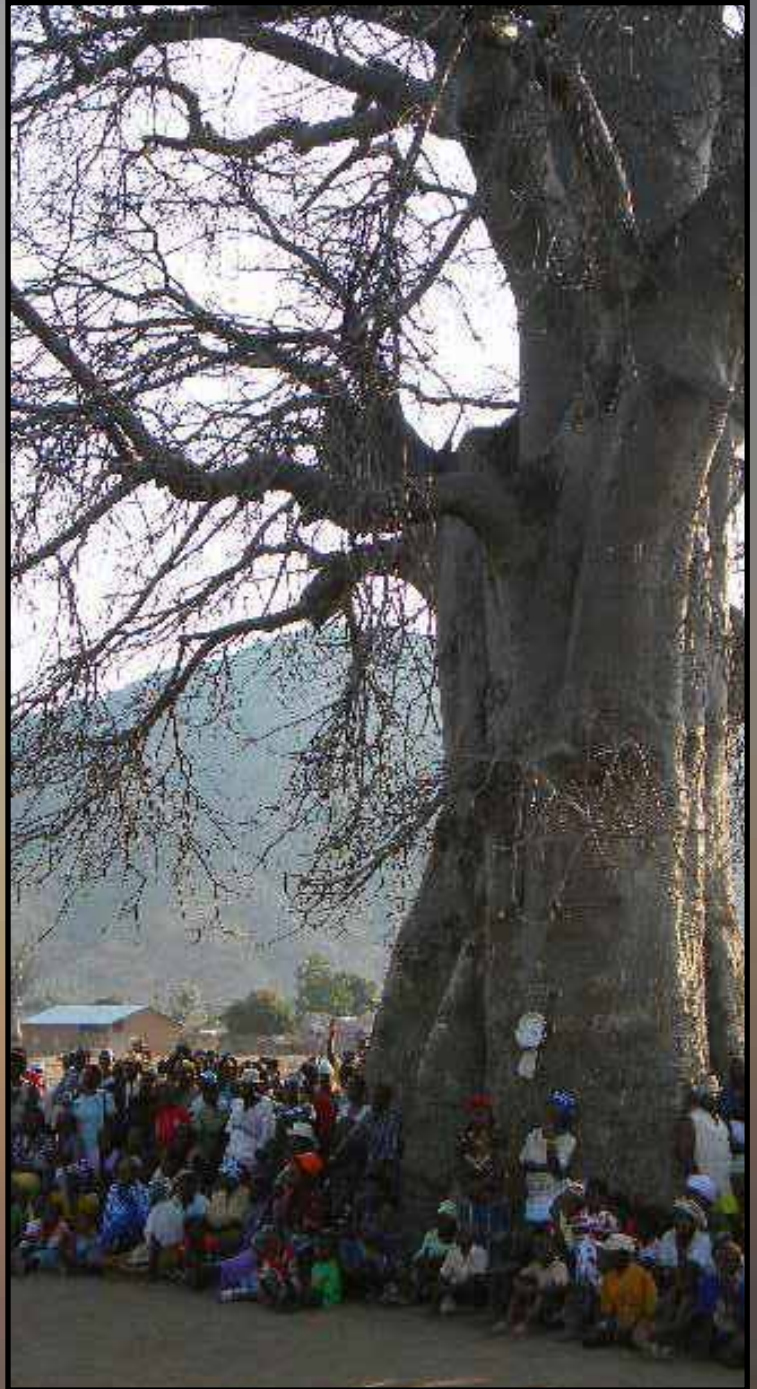
# I Speak for the Trees

Essay and Photos By Bonnie Harvey

Malawi ranks poorly in the United Nations' Human Development Index, which rates countries based on life expectancy, educational attainment and purchasing power. The country is also experiencing considerable challenges environmentally, especially with deforestation (UNDP, 2005). I entered the country with low expectations: these have been met but the "Warm Heart of Africa" is still striving to develop.

Thousands of trees are cut annually for firewood and house construction despite laws prohibiting it. In some rural villages so few trees remain that the people have begun cutting precious fruit trees and poaching wood from local forest reserves. Alternatives to wood, such as electricity, solar power, and kerosene, are not economically or socially viable for a majority of Malawians and therefore are not used. Although the government is attempting to battle the problem, the country could also do more to secure the safety of its trees. Potentially with the aid of organizations like the U.S. Peace Corps or non-governmental organizations working hand-in-hand at the village level, behavior changes could arise to source alternative forms of power.

The following photo essay serves as a case study of the deforestation problems in Malawi, focusing on the Usisya Villages in the Northern Nkhata Bay District. Results found here are countrywide observations that can be noted as crucial to the future of Malawi's landscape and life of the people. As a Peace Corps Volunteer, I am a large part of this fight for the local environment as are my fellow volunteers who are working throughout the country on similar projects.



*Ancient Baobabs are seemingly the only trees which have gone untouched. Their size and perceived sacredness has protected them. They are used as gathering places for traditional dances and community meetings. Along the lakeshore they are essential as large bird nesting places (for species like the fish eagle and various egret species) and shade from the heat.*





*Along the shores of Lake Malawi, many people rely heavily on small-scale fishing for their livelihood. Thus, people remain quite poor and unable to replace the use of found wood with purchased fuel or electricity for cooking. In addition, fishermen require dugout canoes, or 'wato', which can only be made from the trunks of large trees.*



*Trees are also used for door and window frames as well as for adding strength to mud bricks. This house is being constructed just before the rainy season and has sourced its trees from near the local health center (taking away shade for visiting patients).*



*A local Nongovernmental Organization (NGO) in Usisya, Temwa (meaning 'to love' in Chitumbuka, the regional language), is working on new tree nurseries which will sensitize the community to the problems of deforestation and donate the saplings to reliable hosts. This is a trend with NGOs and other Peace Corps Volunteers in Malawi as deforestation relates to so many other issues in the country regarding health and environment.*





*In addition to tree nurseries, Temwa is working with demonstration gardens and general agriculture outreach to diversify diets and improve soil quality. Along Lake Malawi's shores, deforestation has resulted in mudslides, silt leaching, and shade loss leading to the inability to adequately nourish crops (such as corn, potatoes, tomatoes, peppers, manioc, and cabbage) for everyday consumption.*



*Peace Corps volunteers and other development workers have begun focusing on rural women's education, thereby improving literacy and health as well as environmental awareness. Until the women understand the importance of alternative power sources, there won't be any behavior change to benefit the trees. (Photo taken at Mua Mission, a museum in the southern district which shows tribal heritage from the country)*



*Women in Usisya hike the surrounding hills to collect wood along the mountain slopes. It is traditionally the woman's job to prepare each meal. Although the bundles are massively heavy, they are necessary as wood is the preferred method for cooking.*



The government has implemented a full scale campaign for replanting hundreds of acres with pine trees. Though not indigenous to Malawi, they have proven to be one of the most resilient species. Pine trees are being planted in forest reserves across the country; one such place is in Dedza District [above] at the College of Forestry, which has a capacity of approximately 30 students. Similar replanting campaigns are working in Northern Districts, but currently nothing is being done in Usisya. Having lived in Malawi for just one year as a Peace Corps Volunteer, I predict the struggle against deforestation will take much more time. Until the local people can create cultural change and the government can attend to the financial walls, it seems that Malawi will continue to lose the natural beauty held in its acacia and mango trees. People are working hard, thus some optimism remains as Malawi develops slowly.

## AUTHOR BIO

The author of this essay, Bonnie Harvey (Elon class of '09), was born and raised in the West Virginia countryside. At Elon, she earned a B.A. in International Studies with a concentration on Africa (double minoring in Geography and Africa/ African American Studies). Harvey studied abroad her junior year: winter term in Ghana (with Brian Digre's history and culture course) and the following spring semester at Stellenbosch University in South Africa. She was also active in Elon Volunteers where she served as an intern for one year and later developed a program which would send students to tutor resettled refugees in Greensboro. Currently she is living in Usisya, Malawi working as a Peace Corps community health advisor until July 2011.

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# THE TWIG MAN

By Jeremy B. Jones

*It is not just a case of people remaining in one place; it is of people and their place being entwined.*

-Phillip Shaw Palaudan, Victims

Mama wouldn't have liked that I watched Swamp Thing at Jason Lancaster's. I must've been 8 or so, and I remember the movie being of the R variety, so I never told her about it. I stayed at Jason's house, just above the elementary school, one weekend because it was his birthday. We jumped on his trampoline and played basketball and shot Nerf guns at each other until dark. But when night fell, we ate pizza and watched Swamp Thing on the floor of his living room. All I remember of the movie is the man—the thing—climbing up from beneath the boggy water, sludgy vegetation wrapping entirely his dark body. I can't even remember if he was the protagonist or the thing to fear.

My memory works out Swamp Thing's premise like this: the myriad animate and inanimate fragments in the hazy water fused and formed the living breathing man that rose from the depths. He hadn't existed until the random bits began to coalesce and put life into his materializing body. I don't know if Swamp Thing's actual origins are these. Perhaps there were chemicals involved—an explosion or something sinister. Or maybe a mad scientist. But I don't care to find out because I like watching him emerge from the green water of my mind and thinking that the swamp has cast him top to bottom.

I imagine him before he surfaced, half-developed and suspended in the water; bits of algae that have been breaking and merging for years and years happen onto his arms. Fallen limbs, waterlogged and decayed, decompose across his chest. He takes shape slowly, seemingly randomly, from all that surrounds him. Once Swamp Thing makes his way out, he takes these erstwhile fragments with him, not knowing their lives or histories, only their place.

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In the late nineteenth century, the Civil War a few decades old, coal beckoned them into West Virginia and Kentucky. They tunneled in and under to coax black chunks of rock from the veins of the mountains, covering themselves completely in its dust and breathing in the flecks of millions of years.

But no one was burrowing in the mountains of western North Carolina. Our mountains were worked on their edges and their skin; logging companies were felling and dragging trees across the land, digging out beds always absent of water. After centuries of nothing but worn trails and mangled roads, our mountains saw the railroad wind its way into and through the Blue Ridge. Forests were cleared and timber was whisked away on shiny new rails.

These living trees were plucked from the ground and dismembered, but north of us, in Kentucky and West Virginia, men were digging out remnants, the distant kin of these trees. They were uncovering the shapes of buried hydrocarbon, the ghosts of trees from another world and time.

The hydrocarbons of the Blue Ridge lift and color our land, smearing the horizon blue. But the trees of millions of years before, the trees that had fallen in middle Appalachia, were deluged in mud and water, stilled in time and space. Like Swamp Thing, they lay vulnerably beneath this standing water, waiting. They began to break apart slowly, and their hydrocarbons weren't escaping and blurring the horizon; they were pushing deeper and deeper, growing hotter and madder, until they finally reacted—spewing gases and shooting elements into the earth.

Before the turn of the twentieth century, mines harvested the results—nuggets dark as cave

insides unearthed from the mountain's veins. But like a time warp, the rails of western North Carolina toted not the buried rocks of ancient trees, but the trees themselves. The roots were left for dead; the land was cleared.

And a hundred years later, I come up on this very land with twentieth century trees—trees that managed their way into the world after logging and timber trains. I come upon soil turned and tilled for centuries by the people in my blood, but the trees of the forest where I blurred through my childhood are disconnected from that history—their timelines severed by the entrance of a railroad and a need for pine. My trees are new trees for a new world.



Grandma calls my cousin Isaac The Twig Man. He spends his day driving around in his big truck, his gun ready for a chance to shoot duck, and creeps into the woods to pull out old things for Russ Lyda to sell at the Curb Market in town. The Twig Man—naturally—collects sticks. He picks up rocks and berries too, placing them carefully in jars and baskets, but sticks fetch the most money.

Last year, he pulled a giant stump from the ground in the woods near the old tractor shed. The stump looks like a wooden sun; the roots have all shattered to sharp points, so that it stands twisted and textured, with wooden rays shooting out from its base. We can't believe that he manages to sell these things to tourists

passing through. He ties up sticks that he whittles and people pay for them like bouquets of roses. He rents the stump at 400 dollars an hour. A woman took it for a wedding just last week. These people want pieces of the land—hillbilly souvenirs and accents of mountains.

Lately I wonder if I should buy a hunk from him. I've come back into these mountains after years of living abroad, and I don't know how to get into it—how to take hold of it, how to see me in it. It in me.

Isaac's pulling pieces from it, living in his grandma's trailer above the hayfield and collecting money from the army—comfortably settled on the land of our people. But I have returned from somewhere else, planting shallow roots up the creek, wondering how I know that this place is mine.

Some afternoons I stand out behind the house, planting my feet on the hill above the bottomland that holds the creek in place, and imagine myself seeping into the land. I think of my skin sliding softly into the dirt, my bones stretching like roots, my frame folding into natural nooks. I hold still, waiting for the land surrounding me to stir me, to shape me in its image, to raise me up.

Then I hear the shot. It uproots me from my daydream. It's him: The Twig Man, collecting smooth stones and wrangled sticks on the creek bank downstream while he shoots scattering ducks. Somehow it's comforting. He's making sense of the leftover bits of trees a hundred years after timber trains, Russ is peddling them all in town to out-of-towners, and I'm waiting for the past to stretch surely into the future.

## AUTHOR BIO

*Jeremy B. Jones, a 2004 graduate of Elon, is an English professor at Charleston Southern University, and his essays can be found in Quarterly West, Crab Orchard Review, and Our State Magazine, among others.*

*"The Twig Man" comes from his current book project about the confused identity of his native Blue Ridge Mountains.*



# RUNNING THE FARM, NORTH HAMPTON, JUST THE SIX OF US KIDS

By Jonathan Bolding

All summer driving back and forth to town we watched the neighbor's corn catch the sun and rise from sprout to stem to stalk.  
The old van only failed us once on those trips—  
the transmission dropped out— while we waited we worked on our tans. This isn't anyone's fault. Those days dripped time like we dripped sweat ditching or arguing over irrigation—  
away and offered to the land. Then the heat wave washed away worries of failure with assurance of it. We didn't have water for lettuce—  
watched it wither and die. Worse when a couple cows went.  
It's too hot to fuck. That drove us together like little else could.  
A record breaking one-hundred five for mid July. Bunking in the basement for fear of heat stroke. Why can't we afford air conditioning?  
The calf was stillborn and small, neatly undersize, unnatural, and her mother milked fine like she'd lived and the machine everyday was her child suckling. Goddamn. If that ain't the god damndest thing.  
That drove us apart like little else could. And the fallow field sprouted a thousand wildflowers red as blood. And the fall came on. And we made that last trip to town and where the corn was only tall dead dry stalks.  
We wondered where it could have gone wrong. How did that happen?  
How were we left with so little when the land should be so alive—

## BLACKROCK DIVE TOWER

Salthill Promenade, Galway, Ireland

By Mark Brewin

Concrete crumbles under the salt. Whole chunks from the block bench, the changing locker, exposing rebar underneath rusting into dust, paint from the support poles holding up the rain eaves, one layer at a time, color by color: red, orange, blue.

Graffiti chipped into the masonry is blotted away. These steps molded onto the jetty, odd stairs promenade to ocean, are what we claim and reclaim from the moving tide. Seaweed, slicking everything, scraped from boat ramps,

ladder rungs, the diving boards, so swimmers can climb the tower without slipping and break the water's surface beyond the shallow shore ledge. Winter barely ebbed, Spring still young, and in the rainy cold a man has come here and kicked

the wall for a safe return home. Another man has shed his boots and walked into the kelp whorls, waist high in the surf. A cormorant on the quay tries to swallow a whole sandeel, bobbing his head back to get the whole thing down its throat, inch

by fishy inch, but it cannot give to the small core of its stomach. I don't understand how anyone can maneuver this chilly water, especially this man, unflinching as he goes deeper and deeper. Clouds barrel in as quickly as they go out.

# DEVELOPMENT AND THE ENVIRONMENT:

## *China's Oil Strategies in Angola, Nigeria, and Sudan*

By Brittany Carroll

### ABSTRACT

*This paper examines China's oil sector investment in three African countries – Nigeria, Angola, and Sudan – based on evidence presented in books, journals, and newspapers from the mid-20th century to present. In all three oil states studied, oil sector profits have been captured by local elites while the agricultural sector, traditionally the stronghold of their economies, has been threatened by lack of investment and environmental degradation brought on by gas flaring, spillages, blowouts, and broken pipelines. The resulting poorly maintained roads for the transport of produce and the ruined agricultural lands, poisoned water supplies, and poor air quality harm prospects for long-term sustainability in all three countries. Additional findings included that China has undermined democracy in Nigeria, Angola, and Sudan by offering loans and investments to corrupt governments engaged in human rights abuses after Western oil companies, the International Monetary Fund, and others have refused to support them. Unless agricultural sectors in these countries begin to see greater investment, they will be unable to once again take the lead economically when the oil runs out.*

### INTRODUCTION

Although China was a net exporter of oil through the early 1990s, due to its rapidly growing economy it is now the second largest consumer of oil after the United States. From 1998 to 2003, China obtained nearly 60 percent of its crude oil imports from Southwest Asia (the “Middle East”). However, due to that region's political instability, China has recently pursued energy resources in other world regions, including Africa. Although Africa only produces around 12 percent of the world's oil, by mid-2006, oil from two African countries, Nigeria and Angola, equaled what China obtained from its number one supplier of oil, Saudi Arabia. This study uses primary and secondary sources, including books, journal articles, and newspaper articles, to assess the impact of China's investment in the oil sector on the socio-economic development and sustainability of Africa's three

largest oil-exporting countries: Nigeria, Angola, and Sudan. After outlining China's involvement within the three African nations, a case study analysis of Nigeria explores the political, social, and environmental impacts of China's activities. The findings demonstrate how China's involvement is not one of “just business” but an entanglement of foreign and national policy, social and political motives, and corporate and environmental degradation.

### HISTORY OF CHINA'S INVOLVEMENT IN AFRICAN OIL STATES

China's increasing involvement on the African continent is a manifestation of its changing foreign policy in the last fifteen years. Many experts and critics are still debating the nature

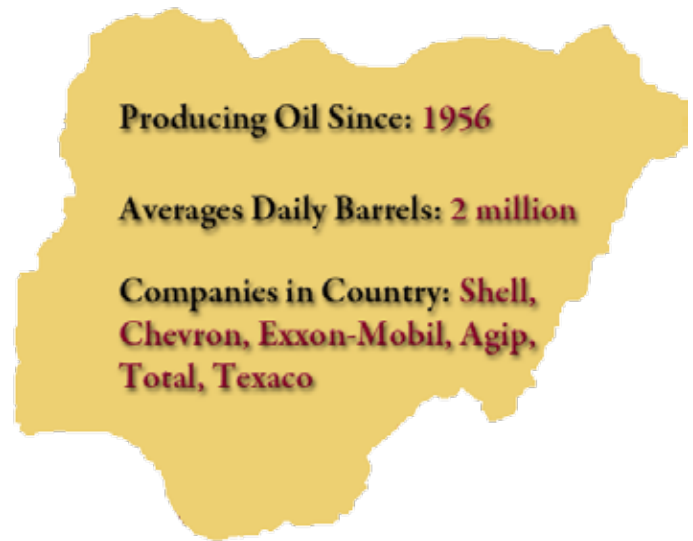
and underlying causes of these changes. Nonetheless, it is clear that China is seeking a more active, arguably capitalist and demand-driven role. The Economist labels this growing relationship as ‘A New Scramble’, a reference to the Western European former colonizers scramble for land, labor, agriculture, minerals, and resources in the late 19th century. Others take a more positive perspective noting that “Sino-African co-operation is considered important for strengthening a multi-polar world and promoting both China’s and Africa’s international positions and influences therein” (Alden, Large and de Oliveira 2008, 145).

African oil trade can be divided into two components: that which occurs within Africa and trade between Africa and the rest of the world. According to a global report, “There is significant oil trade within West Africa and North Africa, whereas there is very little oil trade between African producers and the Eastern and Southern Africa sub-regions” (Joint Study by the African Development Bank and the African Union 2009). Although Africa as a whole is an important player in world oil production—with a total share of 12.1 percent in 2006—due to the region’s low per capita income, the continent only accounts for about 3 percent of the world’s oil consumption.

From 2000 to 2006, Angola in Southern Africa, Nigeria in West Africa, and Sudan in Northeast Africa were the biggest net oil exports on the African continent. All three countries have established oil policies with China over the past two decades. In 2006, Angola accounted for about 21% of trade with China, with Nigeria and Sudan following behind with about 6% (Alden 2007). Examining China’s oil policies within these states is important in that it can help illuminate how similar trade policies have impacted African states that differ substantially not only by location on the continent, but also ethnically, socially, and environmentally.

**Nigeria.** Established as a prospective oil producer in the 1950s while still a British colony, Nigeria has risen as a strategic player in the realm of oil geopolitics and as the world’s seventh largest exporter of petroleum. Prior to Nigeria’s independence in 1960, Nigeria’s oil industry was controlled mostly by foreign oil

## Nigeria



GRAPHIC BY Lindsay Fendt

companies. Post-independence, the Nigerian government strengthened its bargaining power, joining the Organization of Petroleum Exporting Countries (OPEC) in 1971 and purchasing controlling shares in local affiliates.

In the present day, through the joint ventures between the government and multinational oil companies such as Shell, Mobil, Chevron, Texaco, Elf and Agip, Nigeria produces an average of two million barrels a day (Eweje 2006). Nigeria’s economy has shown remarkable growth in the capital-intensive oil sector, but also stagnation, rising unemployment, and decline in agricultural and non-oil sectors. The dependency on oil production has strong implications for increasing wealth disparities amongst Nigerians and loss of investment in the agricultural sector. In addition, due to the ‘easy money’ from oil sales, the avoidance of the collection of taxes from domestic groups has virtually become a state policy in Nigeria. According to one source, “In Nigeria, for instance, taxes were essentially eliminated with the coming of the oil revenues” (Oliveira 2007, 81). The consequences stemming from such policies include the elimination of domestic fiscal revenue as a viable source for other markets such as agriculture, including the cleanup of oil spills on farm land, coupled with the dangerous potential of foreign companies obtaining immense political power within Nigeria’s internal affairs.

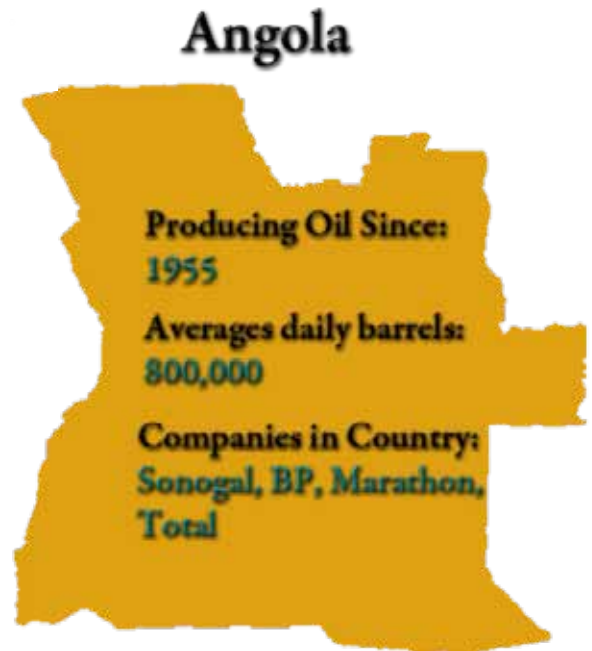


In the case of China's entry into Nigeria's oil markets, the cheap products and joint ventures are seen as a good thing, but are simultaneously not available to the host country and are usually non-contributors to Nigeria's own economy and business factions. The biggest Chinese investment came when the China National Offshore Oil Corporation (CNOOC) "acquired a 45 percent stake in a Nigerian oil-for-gas field for \$2.27 billion USD and also purchased 35 percent of an oil exploration license in the Niger Delta for \$60 million USD in April 2006" (Obi 2008, 422). This acquisition in Nigeria was the largest in the world for that respective year, guaranteeing CNOOC 70 percent of the profits from the Oil Prospecting License (OPL 246), while the Nigerian National Petroleum Corporation (NNPC) would take only 30 percent of the profits but experience 80 percent of the costs.

**Angola.** During the 1960s, oil development in Angola started to take shape as discovery and development of oilfields in Cabinda led to production in 1968. "By 1973, oil had become the country's largest source of export earnings, overtaking coffee" (Hodges 2004, 143). Post independence in 1976, the government of Angola set up the first national oil company, the Sociedad Nacional de Combustíveis (Sonangol) and set out its first petroleum law in 1978. This particular law made it possible for the state to be the sole owner of the country's "petroleum deposits and established Sonangol as the exclusive concessionaire for oil exploration and development, while permitting the state company to enter into associations with foreign companies to obtain the resources needed for oil exploration" (Hodges 2004, 143). Once Sonangol set up joint ventures with western oil companies, the continental shelf off Angola's coast was divided into 13 blocks, which were then offered in stages for bidding by international oil companies.

Since 1983, oil production has risen tremendously following a series of major oil discoveries, which has made Angola a promising place for economic growth. However, like Nigeria, Angola has developed an extreme dependence on this single commodity leaving the country vulnerable to the ups and downs of the international oil market. Although Angola

should have a considerable advantage over most developing countries with the oil wealth that they have accrued, the net foreign-exchange earnings from oil is considerably less because of the dependence on imported goods and services and the repatriation of oil profits. . One of the issues facing Angola is the fact that "the petroleum sector has accounted for over 80 percent of export earnings since the early 1980s and for over 90 percent of exports in some years (Hodges 2004, 154).



GRAPHIC BY Lindsay Fendt

Within the last two decades, Angola has experienced two external shocks, due to changing oil prices on the world market, in 1985-86 and in 1998. Another issue that has risen from the prominence of oil in Angola's economy, as in Nigeria's, is the negative impact on the development of other sectors.

"The state of complacency has also been demonstrated by the low priority the authorities have given to investment in the development of physical and social infrastructure. The situation has been made worse by the fact that public utilities, such as those responsible for electricity and water supply, have been unable to generate sufficient internal sources of revenue because of their inability to set their own tariffs" (Hodges 2004, 157).

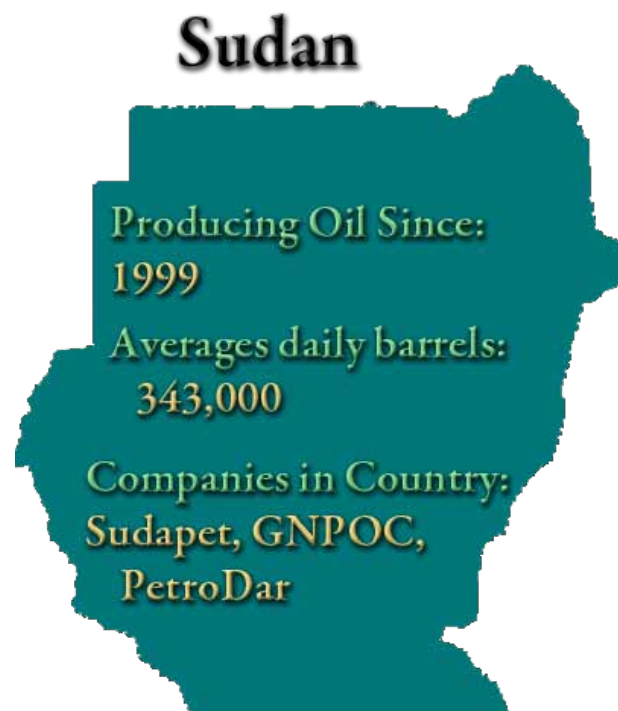
Another factor that deepens the issues of Angola's oil politics is that the government has never had a successful long-term economic or social development strategy in place.

After almost three decades of civil war, Angola has been relatively peaceful since 2002. However, during this period of peace, competition for Angola's oil has become increasingly tense. Marred by a complex history of resources, war, corruption, and poverty, Angola's business environment has received a reputation as one of the most inefficient and fraudulent (Keenan 2009). Some of the most notorious cases arising from Angola's corruption within the oil industry emerged from claims between 2000-2002, in which several allegations of fraud were presented from France and Russia. In Angola's capital, Luanda, reactions to these accusations were marked by denial. Yet, problems resulting from the lack of comprehensive and transparent data about oil transactions, fiscal revenue from oil, off-budget government expenditures, and oil-backed loans have been repeatedly reported to the International Monetary Fund (IMF). In 2004, when the IMF chastised Angola for its corruption and increased its demands for more transparency and management of public resources, China took center stage in Angola's oil policies as it offered a significant aid package that would undermine the conditions set by the IMF. In the 1990s, Angola became China's second largest trading partner in Africa due to defense cooperation. This relationship reached an even higher level in 2004 "when the Export-Import Bank of China (Exim-Bank) pledged the first \$2-billion oil backed loan to Angola to fund the reconstruction of shattered infrastructure throughout the country" (Campos and Vines 2008, 3).

Since the agreement in 2004, cooperation between the two states has been categorized by frequent bilateral visits of important state officials, financial cooperation, extractive industries, bilateral trade, and foreign direct investment. From the outside, many have speculated on the growing relationship between China and Angola. However, Angolan and Chinese leaders have viewed this relationship as pragmatic and strategic. In 2006, Chinese Assistant Foreign Minister, He Yafei, stated in an interview that "China's cooperation with African countries has

helped improve their people's living standards, and brought benefits to both sides" (Angola Press 2006, 1). From Angola's perspective, China is providing the necessary funding for strategic post-infrastructure projects that Western countries and the IMF are not willing to fund.

**Sudan.** From the onset of Sudan's North-South civil war in the early 1980s until the signing of the Comprehensive Peace Agreement (CPA) in 2005, greed, poverty, external intervention, economic exploits, and religious and ethnic divides have created a state racked by violence. "The overarching cause[s] of civil war remained the same as the one before it: a historical consistency of oppressive governance from Khartoum promoting regional marginalization and exploiting social divisions" (Patey 2007, 1000). Oppressive governance fueled by oil only further fueled the conflict. In 1983, the Khartoum-based government continued to marginalize southern Sudan, altering the boundaries to ensure that



GRAPHIC BY Lindsay Fendt

the North would have access to future oil earnings. These actions enraged southerners to the brink of further civil war. Oil development also empowered the government to use brutal military campaigns such as using the Sudan Armed Forces to lay waste on local communities in the South and terrorize civilian populations

with bombers and helicopter gunships. As aggression increased, “international oil companies were seen as complicit in the violence and displacement, providing the government with revenues for large military purchases.” (Patey 2007, 1002).

Sudan’s oil industry was long plagued by the interactions of multinational corporations. Due to the shifting policies in the Yom Kippur War of 1973 and a coinciding embargo against the West, one of the first companies that arrived was Chevron from the USA, which sought to explore other petroleum resources. Chevron conducted extensive onshore exploration activities in Sudan’s basins in the 1970s, after being granted rights following the end of the Sudan’s first civil war. However in 1984, Chevron suspended plans to bring Sudanese oil to market when the facilities were attacked by rebel groups. Between 1984 and 1992 U.S.-Sudanese relations were destabilized, as oil investments within the South seemed risky and entangled in the Sudanese civil wars. “In addition to pressure from Khartoum to either resume its activities or face expulsion, Chevron’s fate was sealed when relations between its home and less-than-gracious host government deteriorated completely and the company was forced to pull out in 1992 (Patey 2007, 1004). With the withdrawal of Chevron and deteriorating relations with Washington, a large portion of the international oil industries such as British Petroleum, Royal Dutch Shell, and Total, shied away from exploration and production within Sudan during the 1980s.

As Western junior oil companies began to pull out of Sudan’s oil industry due to havoc and chaos caused by the Khartoum government, state-owned oil companies from the East began to dominate and secure oil resources in Sudan. In 1995, China National Petroleum Corporation (CNPC), China’s oil company, bought the former Chevron concession and took the lead of the Greater Nile Petroleum Operating Company (GNPOC) in 1997. CNPC’s oil interests have transformed Sudan’s petroleum exports, and have opened the doors for further Chinese investments within Sudan’s economy.

## A CLOSER LOOK AT NIGERIA AND CHINA’S OIL RELATIONSHIP

In Nigeria, the government and oil corporations partner in the exploration and exploitation of oil, devoting little to no investment towards the welfare of the oil producing areas, arguably because most of the oil-producing areas are inhabited by minority groups including the Abribas, Andonis, Edos, Effiks, Gokanas, Ibibios, Ijaws, Ika-Ibos, Ikwerres, Isekiris, Isokos, Kalabaris, Ogonis, and Urhobos (Ikein 1990, 28). In the case of the oil-producing Niger Delta, not only does Nigeria face growing socioeconomic disparities due to the behavior of multinational oil companies, but also environmental degradation. “Providing eighty percent of Nigeria’s income, the Niger Delta has been the center of oil exploration, exploitation, and production since 1958” (Eweje 2006, 34). However, the oil companies are not held accountable for the environmental degradation and socioeconomic pressures placed on the communities within the region. Gas flaring, spillages, blowouts, and broken pipelines,

*“What makes this decline particularly disturbing is that it is not the result of natural causes, but human neglect.”  
(Taiwo and Muraina 2009, 1).*

have not only destroyed agriculture, soil fertility, and plant life, but also has been the source of anger that has led to protests and violence. The effects of the oil boom in the 1970s and 80s led to a severe disruption of the agricultural economy that continues to persist. “The annual production of Nigeria’s major cash crops—cocoa, rubber, cotton, and groundnuts—fell by 43, 29, 65, and 64 percent, respectively.” (Pinto 1987, 432). In the 1960s, Nigeria was ranked among the world’s leading producers of cotton, cocoa, palm oil, groundnut and hides and skins. However, having transformed from a net agricultural exporter



to a major oil exporter, Nigeria now spends more on imports of agricultural products than it earns from its exports. “What makes this decline particularly disturbing is that it is not the result of natural causes, but human neglect.” (Taiwo and Muraina 2009, 1). Perhaps even more alarming is that according to geologists the oil reserves in the Niger Delta, which currently hold 31 billion barrels, will dry and disappear by the year 2040 (Confidential 2010). The lack of discrete environmental and agriculture policy within Nigeria has allowed foreign entities to operate, but not be held responsible for the environmental and societal degradation of the communities within regions such as the Niger Delta, including social disequilibrium, disappearing traditions, increasing violence, riots, vandalism, youth rebellion, and psychological disorientation (Jike 2004).

The implications that stem from China’s new acquisition of companies within the Niger Delta are partially entangled in the local resistance of the region and socioeconomic degradation persistent since the entrance of the first multinational corporations (MNCs). China’s entry is a precarious one, as they are not the first foreign entity to have major control over the oil reserves, and they are not the first to overlook the negative implications within the oil reserve regions. However “indirect” China would like to be, people living in the Niger Delta, see China as becoming a “direct” player in the region’s societal and environmental issues. One of the most prevalent local resistance movements against oil extractions in the Niger Delta has been the Movement of the Emancipation of the Niger Delta (MEND). MEND, comprised of the minority Ijaw people of Nigeria, has emerged as the most daring militant group, tackling longstanding issues of injustice, inter-group inequalities and political and socioeconomic marginalization. MEND and similar local resistance groups are a “growing threat to the hegemony of the Nigerian federal state, the extractive interest of oil companies and the energy security of the world’s power” (Obi 2008, 424). Although Chinese oil companies are not the most directly affected by hostility in the Niger Delta, they inadvertently suffer from some loss due to the violence. One article

relayed, that “attacks by the MEND caused at least 500,000 barrels per day in lost production in 2006 after the violence began. Concomitantly, China’s imports of Nigerian oil in 2006 fell” (Taylor 2007, 639).

*The challenge that Chinese oil companies face today will be based on the position they take in defining their oil policies, securing their stakes within the Niger Delta, and recognizing the demands of the local communities as an integral connection to their successful presence within the region.*

Nigeria and China’s growing oil relationship has had a major impact on development projects within Nigeria and increased Nigerian business ventures in China. As China continues to increase its involvement in Nigeria’s oil industry, it is also entering other sectors within Nigeria’s economy making their relationship unlike other foreign entities within the state. It is apparent that this relationship is not temporary but rather long-term as China’s business ventures become more intertwined in other sectors of Nigeria’s markets, such as infrastructure, communication, and agriculture. The challenge that Chinese oil companies face today will be based on the position they take in defining their oil policies, securing their stakes within the Niger Delta, and recognizing the demands of the local communities as an integral connection to their successful presence within the region.

## CONCLUSION

Beijing is now learning that separating business from politics is easier said than done. “The operations of an oil company in a foreign country, especially one divided by internal conflict, often entangle the company—and its

home government—with the politics of the host country” (Downs 2007, 59). Nigeria, Angola, and Sudan all have been marked by civil wars, political corruption, and local resistance to international investments. China’s entrance into all three of these African states’ oil markets not only shows their drive to become competitive within the international markets, but also will test their degree of ethical and cultural diplomacy. Regardless of whether China’s oil policies directly affect the internal issues within the African states, their presence indirectly portrays a willingness to look past human rights violations. If China wishes to be recognized as a thriving developing economy by Western standards, they must change their non-interference practices for those resembling the international ideals of peace promotion within worn torn-states. The question is whether China cares enough to listen to Western critics or continue with “business.”

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# THE COMMUNITY EFFECT:

## *Attitudes Toward North Carolina's Local Food Movement*



*CSA vegetables arranged for customer pick-up. PHOTO BY Jenny Schnaak*

By Jenny Schnaak and research mentor,  
Michael Strickland

### **ABSTRACT**

*This research focuses on North Carolina consumer attitudes toward local food and how those attitudes affect farmers, and grocery store and restaurant owners. Although many consumers expressed that local food was too expensive and inconvenient for their lifestyle, this research suggested that North Carolinians who do invest in local food do so for health benefits, greater food safety, to reduce their carbon footprint, to contribute to their community and to strengthen their local economy.*



*PHOTO BY ime from sxc.hu*

# INTRODUCTION

Consumer demand for local produce, meat and dairy in North Carolina has increased in recent years, signifying increased demand for local food within statewide and national social, economic and environmental movements. This research focuses on the attitudes that North Carolina consumers have toward local food and how those attitudes affect farmers, grocery store owners, and restaurant owners. For the purposes of this research study, the definition of the local food movement is the practice of supporting small farms by buying locally-raised meat, dairy, and produce and therein helping build a stronger community, as well as educating people on where food comes from and how to prepare it. Consumers find value in buying locally for many reasons, such as food safety & health (less handling and processing, usually pesticide-free and non-GMO), freshness (consumption sooner after harvest), reducing carbon footprint (less distance traveled to reach consumer), knowing food origins (peace of mind), building a tighter community (able to look farmer in the eye), and keeping money in the local economy.

## OVERVIEW

Over the past several years, sizable growth and success in the way of local farms, farmers' markets, restaurants and food cooperatives has occurred in North Carolina. As a collection of small communities, and as a state, North Carolina has demonstrated great enthusiasm, competence and commitment to the movement of slowing down the food industry and looking inward to local farms and growers for its vegetables, fruits, meat and dairy. It is a notable signifier of North Carolina's marked success in the movement that Chapel Hill was named the 3rd best city for local food in July 2009 by the Huffington Post.<sup>1</sup> Reflecting the popularity of local food in North Carolina, last year the Annual Piedmont Farm Tour, now in its 15th year, "set a record of 13,000 farm visits over two days, making it the largest sustainable farm tour in the country. With interest in local, organic and healthy food at an all-time high, Piedmont residents are eager to get out on farms and see

how their food is grown" (Weaver Stree Market). In return, North Carolinians believe they have been rewarded with increased community revenues, greater fellowship, healthier families, and bolstered confidence of where their dollars are going and where their food is coming from, especially in the midst of a broken food system and a deeply suffering national economy.

According to the 2008 Organic Survey completed by the USDA, there are 246 organic farms in North Carolina<sup>3</sup>, and of those, 131 are officially Community Supported Agriculture farms (CSAs). There are also 139 Farmers' markets across the state, as well as over 22 food cooperatives selling local and organic meat, dairy and produce.<sup>4</sup> These locations designed for the sale and cooperative trade of local food have allowed farmers to create innovative crop marketing techniques including you-pick operations, CSAs, tailgate markets and value-added processing. The consumer demand for local ingredients has continued to increase in North Carolina, and entrepreneurs and farmers have responded by opening up numerous "farm to fork" restaurants specializing in the preparation of fresh, local and seasonal cuisine.

## RESEARCH GOALS

In order to understand consumer attitudes toward local food and perceived benefits of engaging with their local food sources, I surveyed North Carolinians across the state. My primary research questions inquired into why people choose to engage with the local food movement and what consumers believe to be the strengths and weaknesses of the local food system in North Carolina. As a result of my study, I learned why people buy local food, why some people do not, and what can be done to improve the local food system for North Carolina.

As I traveled across the state, I gained an understanding for how communities revolve around local food systems, and in what ways local food is helping build positive views about food, transform communities, and increase respectful treatment of nature for current generations and those to come.



*A scenic view from a farm in Western North Carolina. PHOTO BY Jenny Schnaak*

## RESEARCH PROCEDURES

My research was broken down into three phases to represent the basic route that local produce takes in order to reach the customer: from the grower to the distributor, into the hands of the consumer. I observed that local food usually intersects with people at five types of contact zones affiliated with the local food movement: farms, farmers' markets, food cooperatives, grocery stores, and restaurants. My study involved not only ethnographic observation but also interviews and surveys of farmers, co-op owners, restaurant owners and customers at farmers' markets.

A portion of immersive ethnographic observation occurred first while living and working on two farms in the western and central regions of the state for one to two weeks each. Both farms serve as critical contributors to the local food movement. This part of my research was made possible by the Worldwide Opportunities on Organic Farms

organization. WWOOF allows volunteers to live and work on the farm in exchange for experience and education in organic farming methods and business practices. Research included surveys and interviews of farmers and owners and ethnographic research at farms. Ethnographic observation was an integral step in understanding the farmers' perspective, including their struggles and successes and any commentary they had about the impact of the local food movement on their business. This phase of research helped me build strong relationships with not only the farmers of North Carolina but also local community members and businesses connected with the farms. [picture 3. Caption: Sheep being lead to water on a hot day in on a farm in the mountains. Photo by Jenny Schnaak.]

Another facet of my research included distributing surveys to farmers, customers, restaurant owners, grocery store owners and



co-op owners. The data shown in graphs reflects of the opinions of farmers, restaurant owners or consumers collected from surveys completed online or in person. The surveys contained a different set of questions depending on whether the subject was a grower (farmer), distributor (restaurant, co-op or grocery store owner) or consumer (farmers' market customer or random consumer). All participants were required to be North Carolina residents or serve primarily North Carolina residents. Participants voluntarily completed surveys and consented to IRB agreements. Some participants gave their name while others preferred to remain anonymous. Some participants chose to complete a hard copy of the survey while others completed the survey online. I collected all data over the course of approximately two months, from June to August 2010. Survey participants included 179 consumers, 3 farmers, 7 co-op/grocery stores, and 9 local food restaurants. Survey results offer insight into the changing attitudes of North Carolinians toward their food system and their opinions of local food.

By drawing extensive data from a wide array of individuals, groups and organizations involved in the local food network, I was able to triangulate my data effectively. To acquire a

random assortment of participants fulfilling the customer role in the movement, I sent the online version of the survey to various email lists and listservs. These venues helped me obtain diverse survey participants across North Carolina with respect to social class political views, marital status, age, sex and other marks of diversity.

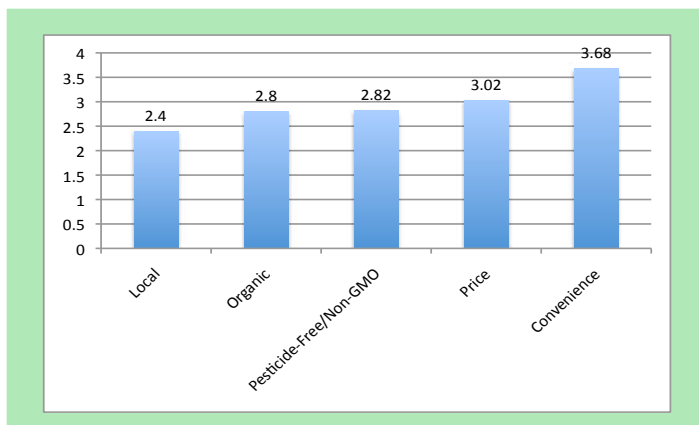
## RESULTS AND DISCUSSION

This data suggests that consumer priority lies in buying local produce, meat and dairy, more so than produce labeled organic, pesticide-free or Non-Genetically Modified Organism (GMO) produce. This signifies that consumers understand that small, local farms are unlikely to use methods harmful to humans and the environment in comparison to the methods of factory farms and agribusinesses. This data also suggests that convenience when buying food is the lowest priority of the consumer.

Following several survey questions, consumers had the option to add any open-ended feedback they had. In this case, consumers had the option to provide additional opinions on the social and economic impacts of investing in local food. These are several examples of open-ended feedback given by consumers:

*Sheep being  
lead to water  
on a hot day on  
a farm in the  
mountains.  
PHOTO BY  
Jenny Schnaak*





*Consumer feedback :What is most important to you in purchasing produce, meat, and dairy? Rank in numerical order of priority, 1 being your first priority. Note: The shorter the bar on the graph, the higher the priority in purchasing.*

*"Many of our CSA members come to our farm store to pick up bag...many meet other folks and they also tell other folks. Our CSA is often a heavy bag, so economically, the members are getting more than what they paid for and better quality."*

*"People who make relationships with each other are more supportive of each other. Knowing the person you buy products from also gets you more involved in other aspects of your community, such as land management, conservation, sustainable practices in the home, etc. When you shop locally and make a relationship with the people you buy from, you naturally expand that relationship into other areas of community life...you become people-oriented instead of product (or object)-oriented."*

*"The public gets to know the farmers and the money stays very local. People feel good about giving their hard-earned money to real people instead of corporations - even if they're health-food chains."*

*"From a pure economic perspective, it is a much more efficient market because the producer is closer to the consumer. If I'm supporting a local farmer and they are doing better financially, they can add more jobs, they can sell/support markets like various farmers' markets, which creates more local jobs. It creates a more local supply chain as well."*

This data suggests that consumers want more restaurants selling local food because discomfort working with raw and unfamiliar vegetables still exists. It would therefore make

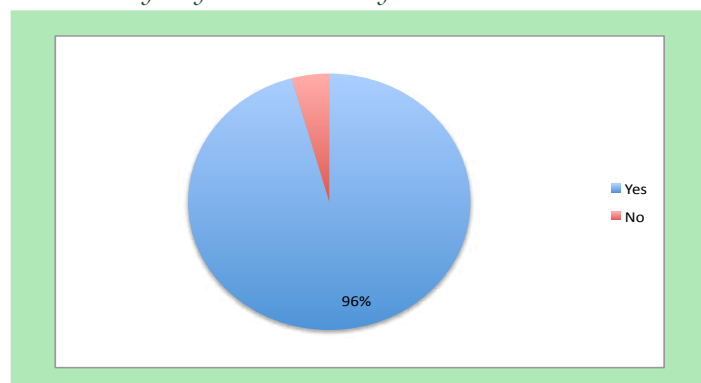
sense for restaurants to take the risk to buy higher quality, local ingredients. Farmers may benefit from giving restaurants a price break, incentive at first to build demand. This data also suggests that consumers still think it is inconvenient to buy local food. For local food to have a greater presence in the regular routine of consumers, chain grocery stores would benefit by strengthening partnerships with local producers in order to meet consumer demand for local food. Increased advertising campaigns for CSAs and farmers' markets may also improve visibility of local food buying options.

This data suggests that there is stigma surrounding the price of local food. Many people believe that local produce is more expensive than that of large national and international agribusinesses. Several examples of additional open-ended consumer feedback support this theme:

*"It's for rich people, not for people on smaller incomes. It's also for people with the luxury of time to savor the choosing, preparing, and eating of food. My lifestyle means preparing lots of one dish, and eating it over several days at my desk at work or as an afterthought at home when I'm hungry. The slow local food movement is not a part of my lifestyle at all."*

*"The more people who eat this way the less expensive it will become, but currently eating locally and organically remains a rich choice. Converting this movement into a sustainable social movement, in addition [sic] to a sustainable economic movement (which I think it has already become), will require making it accessible to a wider socio-economic audience."*

*Consumer feedback: Do you think investing in local food sources such as CSAs has greater benefit both socially and economically to your community?*



*“Unfortunately I have felt that the “local food movement” is an elitist social function for most people. It is the new and ‘green’ version of joining the Country Club.”*

Numerous survey participants, consumers in this case, had the option to add any open-ended feedback to this survey question about their food-buying habits. These are some examples of additional opinions they expressed:

*“I haven’t really changed anything about the way I eat or spend money, so I feel kind of guilty that I don’t do much more locally.”*

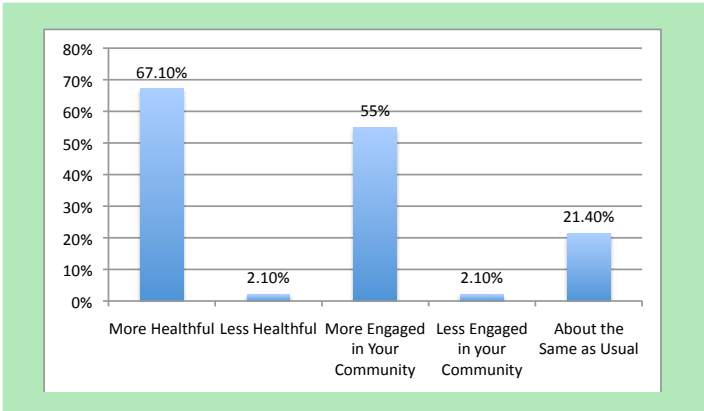
*“I feel like I’m getting to know NC by the foods I eat, a lot of peanuts in eastern NC!”*

*“I now know our local growers by face and name; I ask questions about how they raise their crops and I feel confident that they are safer and healthier.”*

*“I know that I’m giving my family the best food available in hopes that my children will grow up healthier, with fewer environmentally caused illnesses.”*

*“I also seek to reduce my carbon footprint whenever possible and buying local is one way that I achieve that goal.”*

*“I buy mainly from the farmers’ market, the interaction is spirit-lifting in so many ways.”*



Consumer feedback: How have your food buying habits lately made you feel? Check all that apply.

*“Food builds community. What we choose to eat and how we eat it fuels compassion and connection.”*

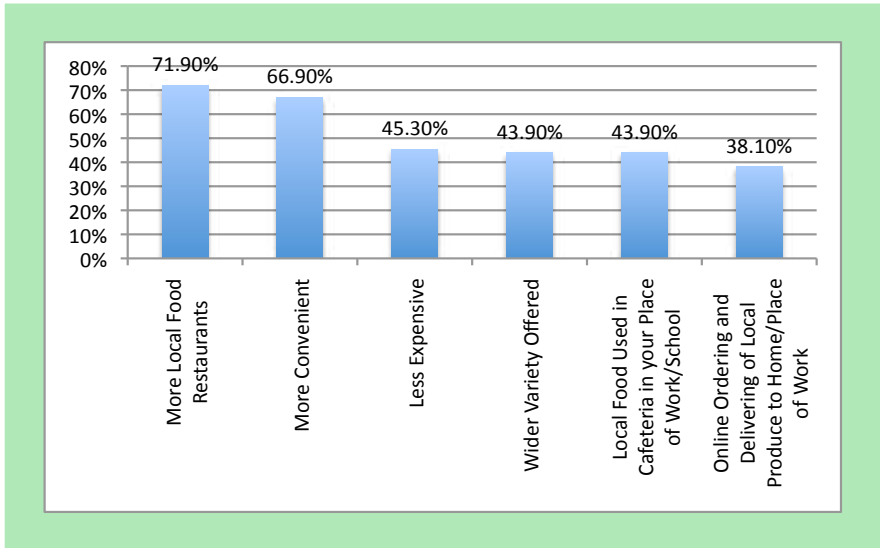
This data suggests that restaurant owners are getting to know their local growers, and also potentially growing their own small gardens on site. This aids restaurants in knowing what produce is in season as well as the animal husbandry practices resulting in the meats they serve. This practice offers more accurate information to the consumer about the origins of their food.

## CONCLUSION

Although many consumers expressed that local food was too expensive and too inconvenient for their lifestyle, this data suggested that North Carolinians who do invest in local food do so for the health benefits, greater food safety, to reduce their carbon footprint, and to contribute to their community and strengthen their local economy.

In order for the local food movement to be accessible to all socio-economic classes, and to be perceived as such, an increase in education about regional produce is required. It is important to the economic sustainability of the local food movement, and therein to the region’s food security, to increase

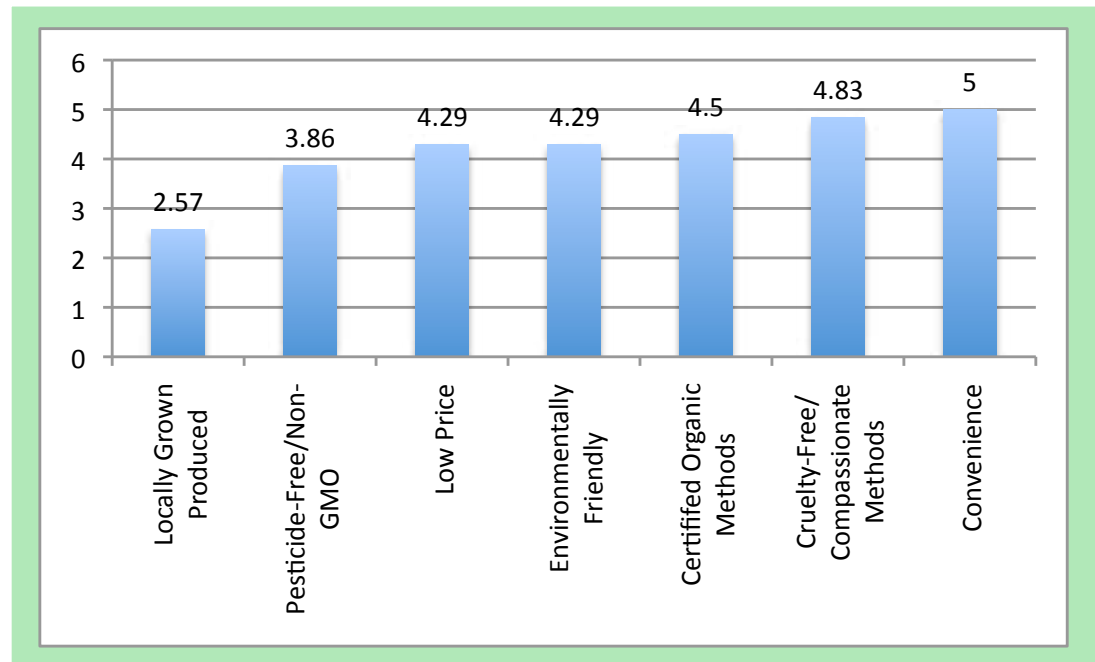
*Consumer feedback: What features would you find helpful in order for you to buy or consume local produce more frequently than you do currently? Check all that apply.*





*Survey Results: What is most important to you in purchasing produce, meat, and dairy? Rank in numerical order of priority. Restaurant owner feedback.*

*Note: The shorter the bar on the graph, the higher the priority in purchasing.*



awareness of nutritional and caloric values of local food, as well as affordability of local produce, meat and dairy. This awareness should seek to inform participants about gardening, seasonal produce availability, and how to cook local produce while maximizing value and minimizing waste of money and food. Access to this educational outreach need not be limited by income, religious affiliation, race, ethnicity, class status or geographic location. These initiatives and programs need to take place in community

spaces where there is observed to be an accessibility problem or an informational deficit surrounding fresh, local food. Restaurant owners, grocery store owners and farmers' markets would also benefit by advertising the affordability of their offerings and helping make local produce a more convenient choice by location. The results of increasing convenience and affordability of local food will likely be a tighter community, healthier families, and increased food security.

## AUTHOR BIO

Jenny Schnaak is a senior English major with a concentration in Professional Writing and Rhetoric and minors in Sociology and Multimedia Authoring. She is co-editor of Visions Magazine, Cooking Shift Leader for Elon University's Campus Kitchen, and an active participant in the Elon Community Garden. After graduation she will be grant writing and assisting in outreach for a North Carolina non-profit organization that educates on renewable energy and local food.

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# SOCIAL, MEDICAL AND ENVIRONMENTAL PERSPECTIVES ON MALARIA IN MALAWI

Article and Photos by Alyssa Morley

## ABSTRACT

*Malawi is an important case study in understanding malaria in Africa because of recent World Health Organization (WHO) support of the use of dichlorodiphenyltrichloroethane (DDT) as a malaria control mechanism. Malawi's unique environment and agrarian economy make discussions of DDT use particularly relevant. This paper reviews current literature surrounding the need to address malaria in Malawi as well as whether DDT is the appropriate preventative measure. Three informal interviews were conducted with people living in Malawi in order to understand how malaria and malaria-prevention affect the lives of Malawians.*

# INTRODUCTION

Malaria is a mosquito-borne parasitic disease that causes fever, chills, anemia and potentially death. Many tropical, and particularly African, nations are tremendously burdened by the disease. Farmer (1998) writes that many “tropical diseases” primarily affect the poor: “Groups at risk for these diseases are often bounded more by socioeconomic status than by latitude” (100). Diseases such as malaria can be a product of both social situation and physiological condition. This paper explores the ways the physiological condition of malaria has intersected with social spheres to influence many levels of “health,” and the social and health implications of the usage of DDT to eradicate malaria.

Malawi was selected as a critical country for exploring malaria in Africa for several reasons. As an agricultural economy, the documented environmental consequences of DDT to animals as well as agricultural produce create a conflict of interest between economic development and health. In 2007, The Lancet wrote that agricultural experts are afraid that European nations may restrict trade with Malawi due to the use of DDT (“DDT for Malaria Control,” 248). Malawi’s unique wildlife population make it a great place for tourism and vulnerable to the effects of DDT. Lake Malawi, for example, is renowned for having the greatest amount of fish diversity in the world (Kidd, et al. 2000, 16). Finally, Malawi was selected because it is host to the most lethal of these parasites, *Plasmodium falciparum* (CDC, 2004).

The leading cause of death in Africa (and Malawi) is malaria (Munthali, 2007). In 2003, WHO and UNICEF issued a press release reporting that 3,000 children in Africa die every day from malaria (WHO and UNICEF, 2003). In addition to malaria presenting a serious health risk on its own, it also exacerbates the problem of HIV (Brentlinger, 2006; Kublin, et al., 2005), increasing the risk of HIV transmission and accelerating the risk of disease progression (233).

## DDT AND MALARIA

Malaria is a salient problem for Africa and Malawi that demands treatment and prevention. Using DDT presents deleterious environmental

consequences, but there are several reasons why governments and the World Health Organization (WHO) find it to be the most effective means of immobilizing malaria.

To begin, DDT is one of the most inexpensive and longest-lasting pesticides available (National Park Service). DDT’s use in the past few decades could be read as a success from a different vantage point. Prothero (2001) indicates that DDT is responsible for eradicating malaria in the United States, Europe, and Zambia (86). Between 1930 and 1950, Zambia was able to eradicate malaria almost completely due to the institution of a rigorous malaria control program. Malaria deaths reduced more than twenty-fold; in 1930, 10.3/1,000 annual deaths were caused by malaria, which dropped to less than 0.5/1,000 deaths/year in 1950 (Brentlinger, 2006: 21). However, Zambia discontinued the use of DDT in 1950, and malaria has regained force as a health threat.

Of course DDT has been documented as negatively impacting human health and ecosystem stability. Activist Malvina Reynolds once sang of DDT: “it kills the bugs in the apple tree. I eat the pie and it’s killing me” (Siberner 2006). While this may be an over-simplification of the effects of DDT, it has been linked to increased risk of breast cancer, birth defects, and other reproductive issues in humans. In a study of 2,000 male malaria-control workers, Salazar-Garcia, et al., concluded that male reproductive health seemed to be impacted by DDT as well.





This research “found an increased risk of birth defects associated with high occupational exposure to DDT in this group of workers [who had been employed spraying DDT for at least one year between 1956 and 1990 in Mexico]” (Salazer-Garcia, et. al, 2004: 542). DDT is often passed to infants in breast-milk and high concentrations of the chemical can result in infant death (960). Chen and Rogan conclude “we estimate an increase in infant deaths that is of the same order of magnitude as that from eliminating infant malaria” (2003, 962).

Also, DDT is a non-discriminating pesticide that can have effects on the larger ecosystem. In the 1950s in Borneo, DDT annihilated the wasp population in addition to mosquitoes. Wasps are predators for a type of caterpillar that ate the thatch roofs of huts. When wasps began dying because of DDT, the caterpillar population soared. As a result, homes were destroyed by hungry caterpillars. Because of Malawi’s specific environmental features, particularly with Lake Malawi and the distinctive cichlid population, DDT poses a unique threat in this situation. Lake Malawi is already affected by DDT. Kidd, et al., noted that in samples from 1996 and 1997, DDT was the most markedly represented pesticide in Lake Malawi (16).

Malaria also has its own set of consequences. Many authors have emphasized the direct connection between malaria and a country’s economic health. Sachs and Malaney (2002) wrote, “As a general rule of thumb, where malaria prospers most, human societies have prospered least” (2002, 681). The Center for Disease Control explained that in Malawi, an average of 25% of a family’s income goes to malaria treatments (2004). Another way malaria

*“When they get Malaria,  
it’s like they’re dead.  
They’re like zombies.”  
- Malawian Peace Corps  
Volunteer*

impacts the economy is through removing individuals from work and school. In C’ôte d’Ivoire (a West African country), between 1999 and 2002, 58% of days from lost work were “because of symptomatic malaria” (Brentlinger, 2006: 19).

While DDT is harmful to human and ecosystem health, the economic benefits of using DDT are undeniable. Munthali writes that “DDT provides a better alternative to the huge costs of hospital admissions, drug procurements, and inactive labor” (2007). Additionally, it is thought to be the most effective pesticide with the longest lasting results (National Park Service). However, the environmental and health benefits of identifying a new insecticide could be worth the time and money. Pyrethroid, for example, is thought to be just as effective as DDT but with less of an environmental impact. The Malaria Foundation International explains that pyrethroid may be up to three times as expensive as DDT, but “these pesticides are less toxic to wildlife and biodegrade far more efficiently than DDT” (Boseley, 2003).

## INTERVIEWS

Esnarte Gondwe, a 30-year-old farmer living in Bolero in northern Malawi, explained that malaria is a very familiar disease in Malawi. “Malaria for us is very common,” she said. “It is like sneezing.” She estimated that most people living in Malawi have probably had malaria at least once, and that it is a major killer of Malawians (especially young children). Margaret Sessa-Hawkins, a 23-year-old Peace Corps Volunteer who has stayed in Malawi for more



than seven months, lives with a Malawian family. Several members of the family have been afflicted with malaria. Margaret explains that even though malaria can be treated, it makes people lifeless for a few days. "When they get malaria, it's like they're dead. They're like zombies."

Malaria is so familiar that many people do not treat it as a serious disease. Margaret has seen this, and said that when speaking with her students about malaria, she can become quite frustrated. "My students know malaria is a big killer. They know that malaria can be prevented using bed nets, and that bed nets are only 50 Kwacha [less than 40 cents]. But they don't take active measures

to protect themselves from malaria." Similar frustrations register with Esnarte. Esnarte has had malaria several times, and has treated her children for malaria. She sees many Malawians who "do not understand how dangerous malaria is...they will just go to the traditional healers instead of the hospital. The traditional healers will give them some

plant, and the person will not get better. Eventually, the malaria will travel to a person's head [cerebral malaria] and the person will die. Then the traditional healer will say, 'Oh, it was witchcraft.'" Jolly Chipofya, a 32-year-old teacher said that malaria is also a huge obstacle for education. It is the leading reason teachers and students are missing school. "Malaria is a big problem, one that affects many different aspects of Malawi," Jolly explained. In addition to damaging the health of individual animals and ecosystems, malaria has economic and social implications and highlights severe infrastructure issues in the country. Hospitals are hard to come by in Malawi, leaving many of the malaria-stricken with a hard decision: either take a few days off work to walk to the hospital when they are already feeling weak, only to wait in the long lines; or simply head to the local traditional healer. Jolly explained that traditional healers

"are mostly good," but some diseases are too strong and too resistant for traditional medicine. Jolly said that Malawi should construct more medical centers or recruit doctors who will travel into the villages to deliver treatment.

## RECOMMENDATIONS AND CONCLUSIONS

From this research I would recommend infrastructure improvements and an emphasis on education to help Malawi manage the problem of malaria. However, there is only one way to abolish the problem completely. Many people,

such as Margaret and Esnarte, believe that the "eliminating the mosquitoes" should be the eventual goal. However, chemical warfare is not the only option. Margaret has seen the introduction of fish ponds work as a way to control mosquito populations, because the fish eat the pests. This would need to be in conjunction with pesticides that select

for mosquitoes. Pyrethroid is an alternative that should be researched in detail. A challenge to implementing more expensive interventions is finances, as well as differences in policies of neighboring countries.

Malaria-control programs must be a collaborative pan-African effort in order to significantly reduce the threat of malaria. Even if Malawi were able to significantly curb malaria using aggressive malaria-control measures, the disease could quickly return if neighboring countries did not implement similar malaria-control programs. In the event that chemical intervention is necessary, a "whole-system" approach should be utilized (Farmer, 1998; Brown, 1998; PAN Africa, 2007). Paul Farmer (1998) explains that in order to eradicate malaria, "improved housing, land draining, mosquito repellents and nets" must be introduced. In 2000, only 13% of homes in Malawi had bed nets;



only 5% had insecticide-treated bed nets (CDC 2004). These figures highlight the clear need to empower individuals to take personal measures in combating malaria. Malaria control programs should involve individuals and communities in order to deliver sustainable results.

The issue of finances is paramount to the discussion of malaria in Africa. An underlying theme in this research has been the influence of money on the individual experience of malaria, as well as a country's experience of malaria. Prothero (2001) writes that medical advances may have the potential to rid the world of malaria. However, these advances mean nothing if they are unaffordable. Research must be conducted on alternatives to DDT, and a whole-system approach should be aggressively undertaken in order to deliver sustainable malaria control.

## AUTHOR'S NOTE

*It should be noted that a belief in witchcraft contributes heavily to a sense of lack of efficacy, especially in the villages. With diseases and disasters such as car accidents, witchcraft is often seen as the culprit rather than preventable factors, like drinking untreated water or riding in cars without brakes. Witchcraft is a very delicate subject for many Malawians, but the scapegoating can be dangerous.*

## AUTHOR BIO

Alyssa Morley graduated in spring 2008. While at Elon, she was an Elon College Fellow and majored in anthropology. Since the fall of 2008, she has been teaching at a secondary school in Northern Malawi as a Peace Corps Volunteer.

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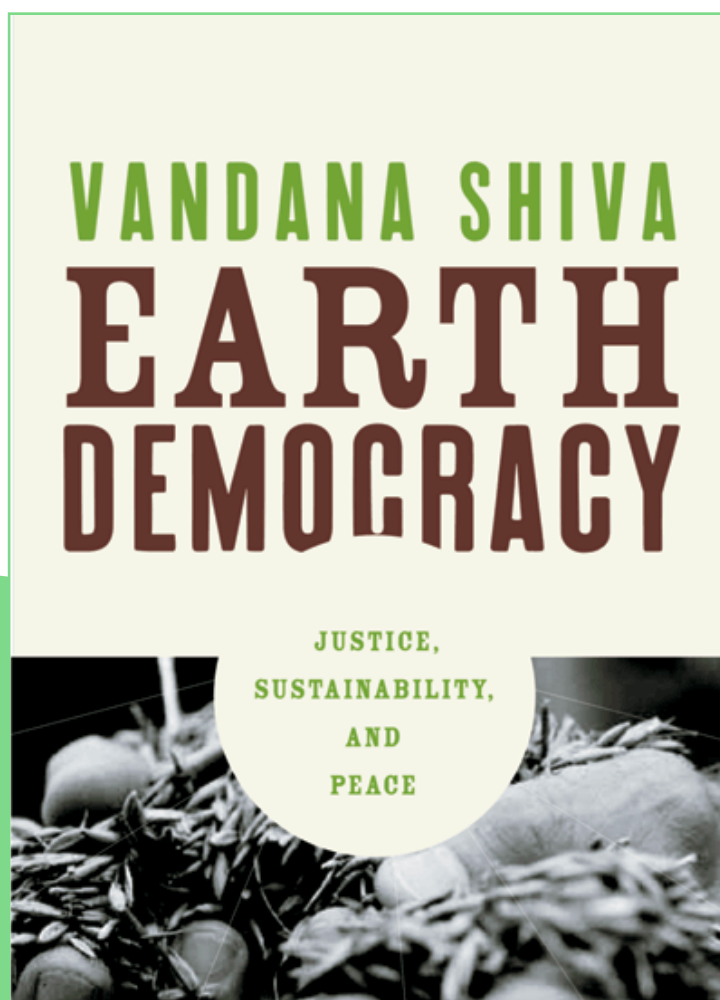
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# BOOK REVIEW OF VANDANA SHIVA'S EARTH DEMOCRACY

By My Nguyen

In a global era characterized by the aggressive privatization of environmental resources and multinational corporations' rule of politics, culture and economic policies, comes *Earth Democracy*, Vandana Shiva's bold and masterful critique of corporate globalization and hopeful vision for the future. A leading voice in the movement toward global justice and sustainability, Shiva outlines the foundational principles necessary for an "earth democracy" movement in three sections: living economies, living democracies, and living cultures.



*Cover of Earth Democracy by Vandana Shiva*

In India, there exists an ancient worldview referred to as *vasudhaiva kutumbkam*—the earth family. This belief fosters the idea of a community of all beings supported by the earth, wherein the human and non-human are interconnected. Certainly, similar language has existed elsewhere in the world to emphasize the importance of protecting, celebrating, and enjoying life. It is upon this universal view that Shiva bases her call to action—or, perhaps, call to peace—in

Earth Democracy. Earth democracy then, is not only an ancient worldview, but also an emerging contemporary political movement.

Comparing and contrasting the top-down systems of authoritarianism and exclusionism with the bottom-up systems of egalitarianism and mutual cooperation, Shiva explains how corporate power threatens the democracy and viability of the planet. Furthermore, she connects the insecurity wrought by globalization with the “ideologies of exclusion” and “cultural nationalism” that fuel war and terrorism. She argues that a mutually supportive network of educated, empowered local communities might be able to create a global society rooted in the principles of peace, compassion, solidarity, and earth family.

Shiva identifies similarities in the earlier eras of enclosure and colonialism in 18th century Britain with present-day struggles over intellectual property rights, patents, and the use of law to privatize natural resources for profit. Contending that overconsumption by the privileged is the primary cause of environmental destruction and human injustice, Shiva supports granting local communities more control over resources so that sustainable economies can be nurtured.

Shiva successfully blends science, history, politics, economics and gender issues into her text without giving disproportionate weight to

any one topic. The result is a book that rewards readers with thought-provoking insights and comprehensive analyses. To be sure, the data-driven text can be overwhelming at times, but Shiva rectifies these denser sections with locally rooted stories that she connects back to the world as a whole.

One particularly grabbing moment in Earth Democracy is Shiva’s description of “Victory in Cancun,” referring to a meeting of the World Trade Organization (WTO) in Cancun in 2003. As protestors filled the streets of the city to reclaim democracy, a Korean farmer, Lee Kyung Hae, tragically, but heroically, claimed his own life. Wearing a large sign reading “WTO kills farmers,” Lee climbed a barricade that had been raised to keep dissenters at bay and stabbed himself. He had with him a note that read, “I am taking my life so others may live.”

While Lee's example is extreme, and Shiva certainly advocates positive ways to reclaim peaceful and secure futures, the instance illustrates the magnitude of earth democracy and the passion of those fighting for a just and sustainable future. Shiva perhaps explains it most eloquently when she says: “We ARE the food we eat, the water we drink, the air we breathe. And reclaiming democratic control over our food, water, and ecological survival is the necessary project for our freedom.”

## ABOUT VANDANA SHIVA

Vandana Shiva is a world-renowned environmental thinker and activist. A leader in the International Forum on Globalization along with Ralph Nader and Jeremy Rifkin, Shiva won the Alternative Nobel Peace Prize (the Right Livelihood Award) in 1993. Director of the Research Foundation for Science, Technology, and Natural Resource Policy, she is the author of many books, including *Water Wars: Privatization, Pollution, and Profit* (South End Press, 2002), *Protect or Plunder? Understanding Intellectual Property Rights* (Zed, 2011), *Stolen Harvest: The Hijacking of the Global Food Supply* (South End Press, 2000), *Biopiracy: The Plunder of Nature and Knowledge* (South End Press, 1997), *Monocultures of the Mind* (Zed, 1993), *The Violence of the Green Revolution* (Zed, 1992), and *Staying Alive* (St. Martin's Press, 1989). Before becoming an activist, Vandana Shiva was one of India's leading physicists.

*Taken from Earth Democracy by Vandana Shiva*

# WHO'S COUNTING?

## *Water Scarcity in Developing Countries*

By Katherine Kenney

In the words of the WorldWatch Institute, "Water scarcity may be the most underappreciated global environmental challenge of our time" (Barlow, 2007). Although water scarcity poses a major challenge to developed and developing countries alike, it represents a special concern in developing countries where millions of people already lack sufficient access to water for drinking and sanitation. Today, development goals are driven in large part by the Millennium Development Goals (MDGs), established by members of the United Nations in September 2000. The MDGs outline eight main goals with twenty one quantifiable targets, one of which specifically pertains to water. Target 7C, which falls under the broader goal of ensuring environmental sustainability, aims to halve by 2015 the proportion of the world population without sustainable access to safe drinking water and basic sanitation (United Nations, 2010). In developing countries, water scarcity presents a major challenge to the achievement of this target, influencing problems related to both public health and environmental sustainability.

- Many developing countries lack access to safe drinking water partly because Earth's water resources are distributed so unevenly between continents. Two-thirds of the world's population

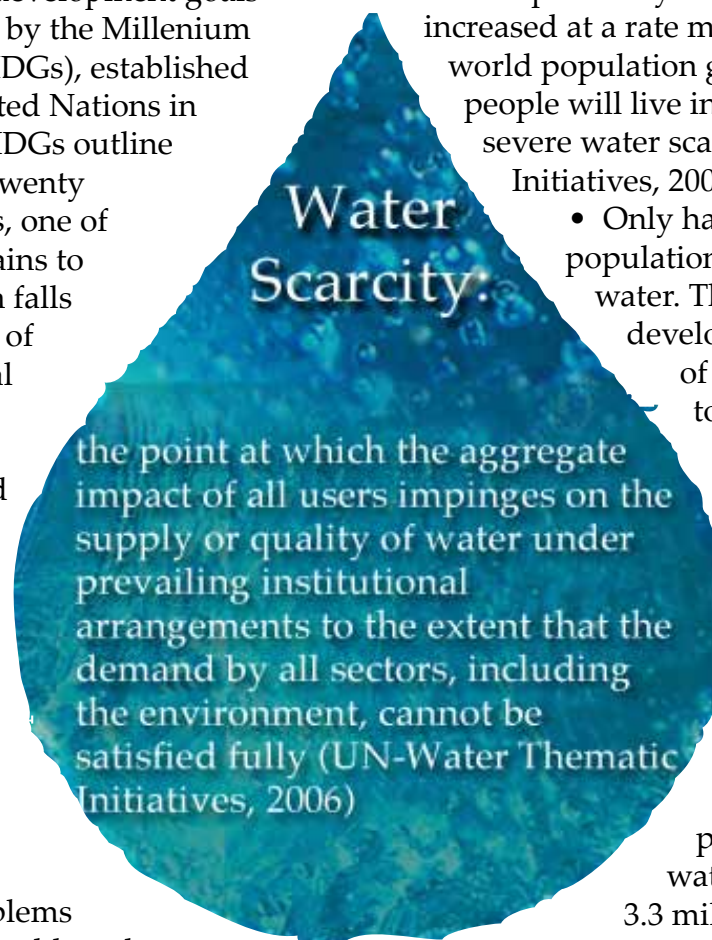
live in locations that receive only one-fourth of the world's annual precipitation, and in many such places, precipitation is seasonal. India, for example, receives 90 percent of its annual precipitation during the monsoon season between June and September (Pennington and Cech, 2010).

- Increased water consumption has led to greater problems of water scarcity. In fact, over the past 100 years, global water use has increased at a rate more than double that of world population growth. By 2025, 800 million people will live in areas characterized by severe water scarcity (UN-Water Thematic Initiatives, 2006).

- Only half of the world's total population has access to piped water. The situation is worse in developing areas; only 4 percent of the population has access to piped water in Africa, 12 percent in South Asia, and 8 percent in Southeast Asia (Wallace and Coles, 2005).

- Every day, nearly 2 billion people on the planet deal with problems related to unsafe drinking water. In developing countries, 80 percent of all illnesses are water-related, amounting to 3.3 million deaths annually. Such illnesses include diseases caused by E. coli, salmonella, cholera bacterial infections, and parasites (Pennington and Cech, 2010).

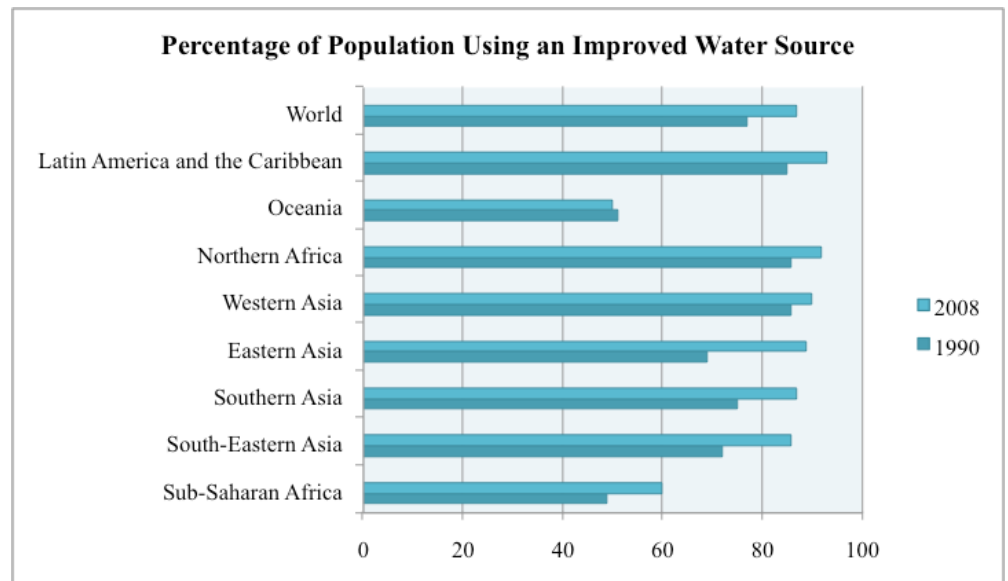
- Despite ongoing problems related to unsafe drinking water, significant improvements have been made and the world is on track to meeting





the MDG goal of halving by 2015 the proportion of the global population without sustainable access to drinking water. In fact, it is estimated based on current trends that by 2015, 90 percent of the world's population will use improved drinking water sources (World Water Assessment Programme, 2009).

- While access to drinking water in developing countries has improved, sanitation continues to be a major problem. According to the United Nations, the world is not on track to meeting the MDG goal of halving by 2015 the proportion of the world's population without access to basic sanitation. At current rates, the number of people with access to improved sanitation sources will increase from 2.6 billion in 2008 to just 2.7 billion in 2015 (United Nations, 2010).



- Open defecation remains the biggest sanitation problem in developing countries (United Nations 2010). Such inefficiencies in sanitation not only result from inadequate infrastructure and water supply to build sanitation facilities, but also contribute to the further degradation of existing water resources (Padowski and Jawitz, 2009).

## AUTHOR BIO

Katherine Kenney is an Honors Fellow and 2012 Periclean Scholar with a double major in Environmental Studies and English. She hopes to pursue a career working with sustainable development and women's empowerment in South Asia.

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