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# Is Lac Anony Reaching Its Tipping Point? A Comparative Case Study of the Traditional Fishery at the Village of Antsovela

Corinne Haynes  
*SIT Study Abroad*

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Is Lac Anony Reaching its Tipping Point?

A Comparative Case Study of the Traditional Fishery at the Village of Antsovela

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SIT Madagascar: Biodiversity and Natural Resources

Fall 2011



*At 4:45 AM in the village of Antsovela, the first morning rays of sun are casting pinks, oranges and blues across the sky, reflecting in the glassy waters of Lac Anony. Men have already set off in their pirogues<sup>1</sup> to retrieve or place their large, indiscriminate fishing nets. Others are wading out waist-deep in the water to collect their cages for catching shrimp. Women wait patiently along the shorelines with baskets and buckets, wrapped up in lambaoanys<sup>2</sup> with their children who grip freshly caught shrimp in their fists as if they are toys. Entire families are preparing their hundreds of meters of bekobo<sup>3</sup> netting that they will place in the lake and consecutively tug back in to shore a half a dozen times this morning. There are always people on the lake fishing: every morning, every day, and every night. In the words of one local, “In the village of Antsovela, there are too many fishermen to count. Almost everyone fishes, even young kids.” Lac Anony is their food supply, their source of income, and their culture.*

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<sup>1</sup> traditional hollowed-out canoe used by fishermen

<sup>2</sup> traditional fabric worn by women

<sup>3</sup> type of beach seining net

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## **Introduction**

### **Overview of Traditional Fisheries in Madagascar**

Traditional fisheries are globally recognized as an important supplier of food resources. In fact, “small-scale fisheries provide over half the world’s wild-caught seafood” (Shester and Micheli, 2011). All around the southern tip of Madagascar, the traditional fishing industry acts as one of the most common livelihoods. The island nation contributes 120,000,000 tons of aquatic resources to the world supply each year, the majority of which is caught by traditional fishermen found in 1,250 rural villages all around the island. However, 80% of the catch is consumed locally, pinpointing the main goal of these traditional fishermen: to feed their families (RAZANOELISOA, 2011). Rural villagers in Madagascar live in some of the poorest conditions in the world, relying on nature for their livelihoods. Madagascar’s annual GDP is ranked 127<sup>th</sup> out of the 177 countries in the world with 50% of its citizens living below the poverty line, and only 30% of the population living in an urban environment (United States CIA, 2011). The remaining 70% of the population dwells in rural regions, including traditional fishing villages. As a result, the importance of fish in the lives of these rural village families is phenomenal, and the necessity to preserve their livelihoods is a matter of life and death.

Due to the rapidly increasing population of Madagascar, the marine and freshwater resources are facing increased pressures. As a result, local governmental organizations, such as *La Service de la Pêche* of the Anosy region, have placed regulations on the traditional industry in order to slow the rapidly changing status of these resources. These regulations, including seasons for fishing and size requirements for shellfish, face increasing pressure from both

conservationists and local fishermen. As catch rates decline and the lives of fishermen are continually challenged by poverty, professionals question the ability of the local governments to regulate the industry.

In terms of lake fisheries in Madagascar, the regulations hold more weight. According to the current Director of fishing in the Anosy region of Madagascar, Chrysostophe RAZAMIFIMANDIMBY, the fish species within lakes are much more threatened because the ecosystems are more sensitive (RAZAFIMANDIMBY, October 4<sup>th</sup> 2011). Slight changes in the environment can rapidly change the populations of species. As a result, excess fishing in a closed lake basin can lead to severe degradation of resources, placing increased hardships on the livelihoods of traditional fishermen.

### **Introduction to Lac Anony and the Village of Antsovela**

*Once upon a time, there were two brothers living in the region that is now claimed by Lac Anony. The oldest brother had lots of land to cultivate crops, and the younger brother was jealous of his prosperity. In a rage of envy, the younger brother killed the elder, but not before the older brother warned that if he inherited the land after his death, it would become unsuitable for crops. After the burial of the older brother, it rained for weeks until all the cultivated land became, to the dismay of the younger brother, a large lake, Lac Anony.*

- The Legend of Lac Anony, as told by villagers in Antsovela

Lac Anony is the largest, brackish body of water in the south of Madagascar, covering 2300 hectares, and is located in the district of Amboasary-Sud between the rural communes of Antanandava and Andranobory. The lake maintains a dynamic relationship with the Indian Ocean just to the south, mixing fresh and saltwater, allowing for the briny environment. From 2005 to 2007, the lake had an open connection to the ocean, allowing for a large influx of marine species into the basin. Due to a lack of rain in recent years, Lac Anony is currently closed off



from the ocean, large sand dunes creating a barrier, called a *vinany* in Malagasy, between the lake and the sea (MARENJAKA and ELISA, 2009). The salty water in the lake allows for a variety of species to thrive, including shrimp, crabs, octopus, jellyfish and over 30 different species of fish. Located in one of the hottest and driest regions of Madagascar, the lake serves as the primary resource for habitants in the area, fishing being the number one livelihood for the rural villagers surrounding it.

The commune of Antanandava sits on the western side of Lac Anony, and is composed of 23 *fokotany*<sup>4</sup>. Antsovela, a village situated to the northwest of the lake, makes up one of these *fokotany* (Ex-President of the *Fokotany*, 2011). Two kilometers to the northeast of the village rests the Sama Sisal Plantation, a remaining influence of French Colonialism. As a result, sisal fields fill most of the surrounding land, leaving little space for cultivating other crops. The village of Antsovela has a long history of both fishing and cultivating crops as livelihoods, but due to the lack of land to cultivate, dry weather, and easy access to Lac Anony, fishing has always been the primary work. In 1953, Antsovela was one of only 5 fishing villages that surrounded the lake, and it was the only village that contained men who chose fishing as their sole livelihood without any cultivated land to supplement (Lamarque, 1953). Today, fishing continues to rank number one as the source of income and food for the villagers, and as a result, the village has a rich culture surrounding the traditional fishery.

17 kilometers to the north of Lac Anony rests the city of Amboasary, where the majority of fishermen sell their catch. The city has a rapidly growing population of 36,082, placing it as the 21<sup>st</sup> largest city in Madagascar (“Amboasary, Madagascar”, 2011). A recent influx of business and students has caused the city to flourish, requiring the construction of a new market

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<sup>4</sup> administrative district

place for the weekly Saturday *marché*<sup>5</sup>. The market at Amboasary is piled high with dry-weather crops such as *bagedas*<sup>6</sup> and corn, and also lots of fish. Fish sold in the market at Amboasary originate from three sources: the Mandrare River, located just to the west of Lac Anony, the sea, and Lac Anony. However, locals rave about the “great taste of lake fish”. A local student describes, “The fish from Lac Anony taste better than any other fish, especially the *angera*<sup>7</sup>, which are endemic to the lake” (Student 1, 2011).

### **Pierre Lamarque’s *Monographie de la Pêche au Lac Anony***

*“La vie est miserable comme nous le disions précédemment, or nous verrons plus loin que la pêche interprétée statistiquement parait très rentable.”*<sup>8</sup> – Pierre Lamarque, 1953

In 1953, Pierre Lamarque, the Madagascar Inspector of Water and Forests at the time, conducted a study of the five fishing villages, including Antsovela, that surrounded Lac Anony. His results, which include a demographic overview of each village, a list of species found in the lake, fishing methods used, and analysis of the most commonly caught species serve as a baseline for this study. In order to gain an understanding of the progression of the traditional fishing industry at Lac Anony, and specifically the village of Antsovela, comparisons between this study and Lamarque’s study will be drawn.

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<sup>5</sup> French word for “market”

<sup>6</sup> Malagasy sweet potatoes

<sup>7</sup> species of fish endemic to Lac Anony

<sup>8</sup> “Life in the region is poor, as stated before, but we will see statistically that the fishing is very lucrative.”(translated from French by the writer)

## **Methods**

For the purpose of this study, four main methods were employed: a village immersion, personal interviews, fishermen surveys, and vendor surveys.

### **Village Immersion**

In order to gain a comprehensive understanding of the life of the habitants of Antsovela, an immersion in the village for a total of 12 days was conducted. A translator lived in the village as well, translating conversations from Malagasy to French. The main goals of the village immersion were to observe, participate and converse with the villagers to learn about their culture, beliefs, and everyday activities. This information put the village into both a contemporary global context, and a historical context in comparison to Pierre Lamarque's study.

### **Personal Interviews**

Personal interviews were conducted both during the village stay at Antsovela, and over the course of five days spent in the town of Amboasary. The purpose of the interviews was to gain specific information about the demographics and lifestyle of the village of Antsovela, the methods of fishing used, and the process of the traditional fishing industry in the region. The translator was used, except for one interview with a student in Amboasary who spoke French and some English. People interviewed include the current President of the *Fokotany* and elders of the village of Antsovela, fishermen and their families, fish transporters in Amboasary and

Antsovela, students in Amboasary, and the current Director of fishing in the Anosy region of Madagascar, Chrysostophe RAZAMIFIMANDIMBY.

### **Fishermen Surveys**

Over the course of 10 days during the village immersion, surveys of fishermen on the shore of Lac Anony near the village of Antsovela were conducted. Each day, any fishermen bringing in their catch from the lake were surveyed about their method used, time spent fishing, and species caught (Annex A). A walk along the shore of Lac Anony bordering the village was conducted one to three times each day, and the time of day of the surveys was varied to gain a broad perspective of fishing on the lake. All species caught by the fishermen were noted and specimens were counted. In the case of species with quantities over 100, or where counting each individual fish was impossible due to the time restraints of the fishermen, an estimation of the number of specimens was decided by the researcher with some aid from the fishermen. A total of 30 fishermen, or groups of fishermen depending on the method utilized, were surveyed.

### **Vendor Surveys**

Over the course of three days in the market at Amboasary, fish vendors were surveyed about the origin of their product, the type of fish they were selling, the cost of each respective species, and the process by which the product came to the market (Annex B). For the purpose of this study, only those vendors selling fish from Lac Anony were considered, a total of nine vendors being surveyed.

## Results

### **Overview of the Village of Antsovela**

*I dove out of our tent at 10:30 PM to see one of the houses only 20 feet from us ablaze. The entire village stood in a semi-circle around the house screaming, running with buckets of water and farming hoes trying to keep the fire under control. Eventually, the flames flickered into coals as the house turned into ash. Everyone stayed in the semi-circle, seated in blankets, watching the red hot wood turn black, and recalled their version of what had happened, relieved that everyone was okay.*

*If disaster teaches us anything, it's that we are all human, from the most primitive situations to the most developed. In the end, we are all destructible, but we are also strong, compassionate and emotional. Honestly, in that moment, I felt the least vazaha<sup>9</sup> I have felt this whole trip, because at that moment, I was part of the community, and a community is a community, especially in a time of crisis.*

- Corinne Haynes, excerpt of personal blog entry from November 11, 2011, during the village stay at Antsovela

Antsovela lies on the border of the Anosy and Androy regions in the south of Madagascar, however, the majority of the inhabitants of the village are of the Tandroy race from the Androy region just southwest of the Anosy region. Almost all of the men in the village practice polygamy, some having up to four or five different wives. As a result, the village is genetically intertwined, each of the over 900 people in the village related to one another. This is reflected in the community of the village, where each family helps each other out, giving food and resources when others are in need. Children take care of younger children, and they look up to all adults as their parents and grandparents. According to the eldest of the village, “All the children in Antsovela are my grandchildren and great grandchildren. We are all family” (Eldest of Village, 2011).

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<sup>9</sup> white foreigner

From a young age, each of the villagers learns how to fish on Lac Anony. In contrast to traditional sea fishing in Madagascar, Lac Anony has no *fadys*, or taboos, associated with it. As a result, villagers swim, fish and play in the lake with no fears. In the words of one villager, “no one ever dies in Lac Anony”, not even young kids going for a swim to cool off (Male Villager, November 14<sup>th</sup> 2011). The dangers and fears associated with fishing on the sea, such as stormy weather, rip tides, being far from the shore, and Malagasy oceanic spirits called *lolodranos* who can capsize *pirogues* and take the lives of fishermen, are non-existent on Lac Anony. This contributes to the all-inclusive atmosphere of the fishery: everyone can fish and everyone should fish to contribute to the family income.

The current total surface area of the village of Antsovela is 51 kilometers squared, and the land cultivated by the villagers makes up an additional 17 kilometers squared (Ex-President of the *Fokotany*, 2011). According to a villager, almost every family in the village grows crops in addition to fishing. The crops are consumed by the families, and also transported to the market at Amboasary to be sold. Common crops grown include sweet potatoes, corn, dried beans, mangoes and sugar cane (Male Villager, November 14<sup>th</sup> 2011). Many of the men, women and children in the village work in the fields in the morning or afternoon in conjunction with fishing at other times throughout the day. However, the majority of the villagers view fishing in the lake as their main source of food and income.

The *fokotany* governing Antsovela also oversees the small village of Ankodida, which lies seven kilometers to the northwest of Antsovela. The total population of the two villages in 2010 was 965, the majority of which is found in Antsovela. This population is broken down into 578 women, 387 men, and 187 households. The role of the *fokotany* is important in a village of this magnitude, and the President holds the highest position. Antsovela follows a rather

democratic process for the selection of a president, an election being held every three years. According to a former president of the village, the villagers often voice an opinion of who they would like to be president, and then all those interested in running are voted upon (Ex-President of the *Fokotany*, 2011).

In addition to having a well-organized *fokotany*, Antsovela boasts two churches and a primary school located within the village. The majority of villagers are Christian, attending either the Catholic or Protestant church regularly. According to the current President of the *fokotany*, the Protestant church was established over 80 years ago, while the Catholic church was established around 40 years ago, both by European missionaries (President of the *Fokotany*, 2011). The current primary school in the village was established in 2003 by the Madagascar Minister of Population, and according to a teacher at the school, 162 students attend regularly, an amount she claims to be the majority of kids who are of schooling age within the village (Female Teacher, 2011). After primary school, children have the option of going to school in the center of the commune of Tanandava, about seven kilometers from the village, or continuing their education in Amboasary. Discussion with multiple villagers revealed that the majority of parents want their children to continue their education, because fishing in the village is not a job that brings in a lot of income. Most of them understand the importance of receiving a diploma for finding a good job in a larger town, and encourage their children to do so. Although a current teacher claims that more than half of the students in the village continue their education after primary school, many end up staying in Antsovela carrying on the fishing tradition deeply embedded in their culture (Female Teacher, 2011).

Besides fishing, cultivating crops, and the possibility of moving to Amboasary to find a good job, a handful of alternative livelihoods are available to the villagers of Antsovela. Many

men and women are employed at the Sama Sisal Plantation to do odd jobs. According to a woman in the village, she works at the plantation on a weekly basis bundling sisal fibers or collecting jojoba berries, which are also grown at the plantation and sold for cosmetic products (Female Villager, 2011). Another source of income provided by the lake is shell collecting. The sand of Lac Anony consists of coarse pieces of shell, which is bagged up by villagers and sold to truck transporters who bring the material to the capital of Madagascar, Antananarivo, for use in construction. The money acquired through this work is shared among the village for development purposes, the lake viewed as a communal resource (Male Villager, November 4<sup>th</sup> 2011).

### **Current Geographical Situation of Lac Anony**



Fish transporters riding along the edge of Lac Anony bordering the *vinany*, the dunes separating it from the Indian Ocean



As introduced previously, Lac Anony maintains a dynamic relationship with the Indian Ocean to the south but is currently closed off by a long chain of sand dunes. According to a former President of the *Fokotany* of Antsovela, there is a consistent cycle of a brief opening of the *vinany* occurring once every seven years. However, during the month of February of 2011, cyclones struck the southern region of Madagascar, heavy rains causing it to break open for a few weeks, even though it was only the 5<sup>th</sup> year of a cycle. This opening caused a huge influx of marine species and seawater into the lake, which have now been trapped within the basin. As a result, the traditional fishing industry on the lake has seen a booming increase in populations over the past few months, especially in shrimp, which have been able to naturally spawn in the closed basin (Ex-President of the *Fokotany*, 2011).

### **Fishing Methods Utilized**

Surveys of fishermen and discussion with villagers revealed four main methods of fishing at Antsovela:

- *Bekobo*: This method is a type of beach seining that utilizes nets made of nylon line as large as 100 meters long that are placed out into the lake with the use of *pirogues*. Long ropes are attached to each end of the net and brought back into shore after its placement. The ropes are pulled by groups of people, around four to six per side, until the net reaches the shore, and fish trapped within are collected in buckets and baskets. This process can take anywhere from 15 minutes to an hour and a half, depending on the distance that the net is placed in the lake. On rare occasions, a *bekobo* may be left in the lake overnight and retrieved in the morning. Men, women, and children of all ages participate in this

method, sometimes placing and pulling in their *bekobo* half a dozen times each day.

When asked how many times his family was going to reel in their *bekobo* one morning, one fishermen replied, “as many times as we can before we don’t have any energy left” (Fisherman 2, 2011).



A family pulling in a *bekobo* net



Fish caught in a *bekobo* net

- *Harato*: This method uses large nets made of nylon line, similar to that of the *bekobo*, but with bigger openings. These nets are placed out in the lake by one or two fishermen with the use of *pirogues* and left in place for several hours or sometimes overnight. When fishermen retrieve their nets, some use long poles to plunge the net in on itself, trapping the fish within it. The nets are pulled back into the *pirogues* and brought to shore to be untangled and the fish collected. Only men conduct this method, because women, who are viewed as “incapable of doing so”, are not allowed to fish in *pirogues* (Male Villager, November 6<sup>th</sup> 2011).



*Sia sia*<sup>10</sup> trapped in a *harato* net in a *pirogue*

<sup>10</sup> species of fish found in Lac Anony

- *Vovo*: This method utilizes cages constructed out of netting and sticks of wood to capture mainly shrimp. The cages are placed before sunset at the end of a row of sticks that the fishermen stab into the ground of the lake. These stakes poke just above the water, creating a line out to where the cage sits. Grass from the shoreline is placed all along the sticks near the cage to create a barrier causing shrimp and other fish to get trapped during the night, many of them finding their way into the small opening of the cage and not being able to find their way out in the dark. Fishermen wade out to the cages to remove them just before dawn, and the catch is collected. Although this method does not utilize a *pirogue*, only men were observed conducting it, and in all cases it was a solitary effort.



Fisherman removing his *vovo* at dawn

- *Takeba*: This method utilizes smaller traps made of nylon netting to capture mainly crabs. This is the only method that utilizes *hofa*<sup>11</sup>, chopped up pieces of smaller fish placed in a small netting compartment in the center of the nets. Fishermen take out a few *takeba* by *pirogue*, lower them to the bottom of the lake and reel them in 15 to 30 minutes later. Due to the use of a *pirogue*, this method is only conducted by men and requires only one fisherman. Fishermen may stay out on the lake for several hours, placing and retrieving their *takeba* multiple times.

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<sup>11</sup> bait



Fisherman preparing his *takeba* traps with *hofa*

Comparison of the four methods reveals the following results:

	<i>Bekobo</i>	<i>Harato</i>	<i>Vovo</i>	<i>Takeba</i>	TOTAL
% used (out of # of fishermen surveyed)	46.6%	40%	6.7%	6.7%	100%
% of specimens caught (out of 10,751 specimens counted)	82.7%	10.6%	6.3%	0.4%	100%
# of different species caught	24	20	11	1 (crabs)	
Avg. time spent in water	1.76 hours	4.45 hours	12 hours (overnight)	7.25 hours	

Figure 1: compares the four methods based on frequency of use by fishermen, percentage of total specimens caught, variety of species caught, and the average amount of time that the different types of methods spent in the lake. This data was collected through surveys of 30 fishermen/groups of fishermen.

This chart reveals *bekobo* nets to be the most commonly used method, almost half of the fishermen surveyed utilizing it. For the *vovo* and *takeba* traps, only two fishermen were observed using each method, and for the *harato* nets, 12 fishermen were observed. *Bekobo* nets caught the greatest variety of species, the greatest number of fish, and required the least amount of time, most likely contributing to its popularity. *Vovo* and *takeba* traps on the other hand took the most time out of the four methods and caught the least amount of species, both in variety and total number, contributing to the smaller percentage of fishermen who relied on them. The *takeba* only brought in a species of crabs, locally called *foza*. However, it brought in the largest catches of crab, amounting to 30 to 40 specimens per use, while crabs caught by other methods were only in amounts of one to four specimens. The need to catch large quantities of fish each day in order to earn money is reflected in the most common methods used; *bekobo* and *harato* nets are the fastest and have the largest range and quantity of species caught, and as a result, they were used by 86.7% of the fishermen surveyed.

*Pirogues* play an important role in the traditional fishing industry at Antsovela, three out of the four main methods relying on the boats for net placement and/or retrieval. Most children, boys and girls, learn to row a *pirogue* by the time they are eight years old, able to go out onto the lake in the boats for a brief ride. However, it is not until boys are 15 years old that they are typically able to fish in the man-made boats on their own. According to an interview with a fisherman in the process of constructing oars for his *pirogue*, many of the villagers construct their own boats from wood from trees such as *fengoke*, *sirosiro*, and *adabo*, found in the surrounding dry forest, the most popular wood being that of the *fengoke* tree. Some fishermen choose to purchase their *pirogues* from vendors from the neighboring village of Ankirikirike who pass by Antsovela on occasion, selling the hollowed out canoes for 50 to 60 thousand

*ariary*<sup>12</sup> a piece, the equivalent of \$25 - \$30 USD. Oars are also constructed from trees found in the forest, the most popular wood being that of the *magne* tree, although *voandela* is also used. According to the fisherman constructing his oars, *pirogues* and oars are typically used for five to six years before new ones need to be constructed or purchased. It is common for fishermen to repair their boats many times before purchasing or constructing new ones (Fisherman 2, 2011).

The other fishing supplies, including nets and nylon line used to fix and create nets must be purchased in Amboasary or Fort Dauphin, a coastal city in the Anosy region located 61 kilometers from Antsovela. Many fishermen expressed the necessity to go all the way to Fort Dauphin in order to find the best netting supplies, especially in order to buy *harato* nets. *Takebas*, *vovos* and *bekobos* can all be constructed by fishermen using supplies found in Amboasary, but *harato* nets must be purchased (Male Villager, November 14<sup>th</sup> 2011). This is a challenge for fishermen in a rural village like Antsovela who do not have the money or capabilities to travel to Fort Dauphin. As a result, many work with old nets that require constant upkeep and mending. This was a common complaint of fishermen, who expressed their desire to have new nets and supplies given to them as gifts or through international aid by NGOs.

The desire to have new supplies donated to the village was realized by international aid in previous years, but not anymore. In 2004, the Madagascar Minister of Population came to the village of Antsovela in order to provide aid and developmental resources. The minister gained international support and was able to give nets and lines to the village. This aid stopped in 2006, and as a result, many of the villagers remember the help that was given to them, and pray for its return. Most of the developmental resources implemented by the Minister of Population were effective, but short lived, the village unable to sustain the functions put in place such as a police station and an Association of Fishing (Male Villager, November 4<sup>th</sup> 2011).

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<sup>12</sup> Malagasy currency

## Species Caught at Antsovela

Surveys of fishermen and groups of fishermen on the shores of Lac Anony identified 40 species within the lake, 31 of which are edible fish, one of which is a blowfish that is considered poisonous, one species of eel, one species of crab, four species of shrimp, one species of jellyfish, also considered inedible, and one species of octopus (Annex C). All species identified were done so with the help of the local fishermen, and as a result, the names used in this study are the common Malagasy names. It is important to note that not all species identified are included in the data collected of the 30 surveyed fishermen of the village of Antsovela. Some species were identified further along the beach near a different village, or as a sole fish and not as a part of the exhaustive catch of the fishermen. The total number of species included in the data of the 30 surveyed fishermen is 34, including 28 species of fish, one species of eel, four species of shrimp and one species of crab, and the total number of individual specimen counted/estimated after the 30 surveys was 10,751. In addition, of the 30 fishermen surveyed, all but one of them returned from the lake with some quantity of catch. This gives a 96.7% success rate of catch attempts on the lake. The most commonly caught species include a type of minnow, *menahariva*, two species of smaller fish, *sia sia* and *gdihy*, and a species of shrimp, *orandava*.

	# of specimens caught	% out of all specimens caught
<i>Menahariva</i>	4,500	41.9%
<i>Gdihy</i>	2,800	26.0%
<i>Orandava</i>	1,735	16.1%
<i>Sia Sia</i>	800	7.4%
TOTAL (out of 10,751)	9,835	91.4%

Figure 2: the number caught and the percentage out of the total number of specimens recorded of the four most commonly caught species by 30 fishermen/groups of fishermen

	<i>Bekobo</i>	<i>Harato</i>	<i>Vovo</i>	<i>Takeba</i>
<i>Menahariva</i>	100%	0%	0%	0%
<i>Gdihy</i>	100%	0%	0%	0%
<i>Orandava</i>	51.9%	10.4%	37.7%	0%
<i>Sia Sia</i>	0.1%	99.8%	0.1%	0%

Figure 3: the methods utilized to catch the four most commonly caught species as percentages

These charts reveal *menahariva* to be the most commonly caught fish, making up 41.9% of all the specimens recorded. It is important to note that this species was also the smallest species identified, contributing to its high percentage of individuals caught. In fact, all three of the most commonly caught species of fish were of a smaller size, many of their counts estimated in this study because of the excessive amounts brought in by *harato* and *bekobo* nets. For the top two most commonly caught species, *menahariva* and *gdihy*, the only method utilized was the *bekobo*, it's small net space size able to capture the small fish. The *sia sia* were of a slightly larger size and were captured almost entirely by *harato* nets. For the *orandava*, a species of shrimp, the most commonly used method was also the *bekobo*. However, this was the only species that had a variety of methods, *bekobo*, *harato* and *vovo*, bringing in a percentage of catch over 0.1%. Three other species of shrimp were also identified in the lake (*orampasa*, *oramena*, and *siskidava*), but their catch counts were minimal. Only three specimens of *oramapasa* and *oramena* and only one specimen of *siskidava* were counted over the course of the study.

### Market Process of the Fishery

The fish caught at Lac Anony follow three possible processes:

- The families of the fishermen consume it.
- The fishermen sell it to other families in the villages surrounding Lac Anony.



- The fishermen sell it to transporters who bring the fish to the market at Amboasary.

Much of the fish caught by fishermen in Antsovela are sold and consumed within the limits of the village. Some fishermen fish only with *takebas* or *vovos*, making their catches species-specific to crab and shrimp. If this is the case, they are known throughout the village as a supplier and vendor of those types of fish. In addition, many young girls find work in the village by frying or smoking small fish and selling them along the shore or within the village. In these regards, the traditional industry has an internal economic flow, money and fish being exchanged from family to family at low costs. However, this flow supplies mainly food, and does not act as the primary source of income for most fishermen.

In order to earn a sum of money, albeit not a large one, most fishermen rely on selling a portion of their catch at the market at Amboasary. This is a process that requires three types of work: fishing, transporting and selling. Due to the distance between Antsovela and Amboasary, bicycles are used to transport fish. The role of the transporter in the market process at Antsovela varies greatly. In some cases, the transporter acts solely as that, biking between Antsovela and Amboasary each day. In other cases, fishermen themselves will bike to Antsovela in order to sell their morning catch to vendors at the market. Finally, some vendors from Amboasary come to Antsovela each day to purchase fish from fishermen. Regardless, most fishermen, transporters and vendors follow a routine: they sell and purchase their fish from the same person each day, creating a system of trust and regularity. Conversations with vendors at the market at Amboasary revealed that many of them “are good friends” with the fishermen from whom they purchased their product (Surveys of local vendors, November 3<sup>rd</sup> 2011).

Fish from Lac Anony normally cannot be found in the market at Amboasary until after 9 AM due to the time needed for transportation. Fishermen sell their catch to transporters, or bring it themselves to town, as early as 5 AM in order to get it to the market as soon as possible. However, earlier in the morning, some vendors can be found selling leftover fish from the day before. According to one vendor, “If I don’t sell all of the shrimp in a day, I put it in a refrigerator and sell it the next day” (Surveys of local vendors, November 17<sup>th</sup> 2011). This is a technique that increases the possibility of sales and income, and decreases the possibility of spoilt product, however it is a rarity for a market vendor to have access to a refrigerator in Amboasary.

There is a wide variety of species of fish from Lac Anony sold at the market at Amboasary. Many are sold as groups of 5 – 8 fish, some are sold as individuals, some are sold per kilogram and others, including shrimp and the small *menahariva*, are sold by the cupful. Vendors may sell only one or several different species of fish. Interviews with nine vendors selling fish from Lac Anony revealed 18 different species being sold in the market (Annex D). Three species of fish, *maliobobo*, *saifotsy*, and *apine*, and one species of shrimp, *orampasa*, were the most common species in the market, each sold by three out of the nine vendors. The prices for these species varied depending on the size of the product and the method of sale (i.e. per group, per cup, per kilo, etc.).

Species	Average Cost
<i>Maliobobo</i>	1,000 Ar/group of fish
<i>Saifotsy</i>	800 Ar/group of fish
<i>Apine</i>	733.33 Ar/group of fish
<i>Orampasa</i>	4,000 Ar/kilo OR 600 Ar/group of shrimp

Figure 4: average costs in *ariary* for the four most commonly sold species at the market at Amboasary

Of the four most commonly caught species at Antsovela, all but one, the *sia sia*, was found in the market at Amboasary. The *menahariva* and *orandava* were sold by two vendors each, while the *gdihy* was sold by only one vendor.

Species	Average Cost
<i>Menahariva</i>	400 Ar/cup
<i>Gdihy</i>	200 Ar/cup
<i>Orandava</i>	300 Ar/group of shrimp
<i>Sia Sia</i>	N/A

Figure 5: average costs in *ariary* at the market at Amboasary for the four most commonly caught species at Antsovela

These charts reveal that the most commonly caught fish cost much less than the most commonly found fish in the market at Amboasary. This seems fitting considering the desire of the fishermen and vendors to earn the greatest amount of money. Because none of the four most commonly caught species were also the four most commonly sold species at Amboasary, it can be inferred that the most commonly caught species are often consumed within the villages. In addition, the four most commonly caught species of fish tend to be of smaller sizes than the four most commonly sold species of fish. This can be seen in the fact that the *menahariva* and *gdihy* were sold by the cupful, and not per group as were the *maliobobo*, *saifotsy*, and *apine*. The average size differences between the *orandava* and *orampasa* shrimp species are unknown, but difference in taste could be contributed to the difference in sales. In general, the fishermen sell the larger, “better tasting” fish to the transporters and vendors at Amboasary in order to earn more money, and they keep the smaller, cheaper fish for themselves and their families.

### Management of the Traditional Industry

*Corinne Haynes: “Are there any regulations on the fishing at Lac Anony?”*

*Eldest of Village: “Tsy misy”<sup>13</sup>.*”

- Interview between writer and eldest of village of Antsovela, November 4<sup>th</sup>, 2011

When asked about regulations on the fishing industry at Antsovela, the eldest of the village and one of his many grandsons shook their heads and replied, “*tsy misy*”, which means “nothing” (Eldest of Village, 2011). However, it is difficult to believe that a lake the size and prosperity of Lac Anony would be completely free of management. Today, even in Madagascar, a country with one of the most corrupt governments in the world, management of aquatic resources is imperative.

Further discussion with the President of the *Fokotany* of Antsovela proved this theory. Lac Anony does have a series of regulations that the traditional fishermen must follow, but their enforcement is weak, many villagers unaware that they exist. According to the President, there are two types of regulations that govern in the region: those that come from the state, and those that come from the commune of Antanandava. The President acts as a primary enforcer of the laws, taking measures to ensure the solidarity of fishermen at the lake. For example, two different types of *bekobo* are used on Lac Anony each known for trapping different species. The President tells fishermen which type to use, decreasing the chances that one type is being used more than the other. This ensures even distribution of species trapped by the *bekobo*. In addition, the President expressed the importance of eliminating the use of *harato* nets with extremely small spaces. This is a regulation put in place by the regional *Service de la Pêche*, or Service of Fishing, however, the President explained that he did not know where each regulation came from, whether it be from the state or the commune of Tanandava, just that he was to enforce them (President of the *Fokotany*, 2011).

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<sup>13</sup> “nothing”

Lac Anony falls under the jurisdiction of the Service of Fishing in the Anosy region of Madagascar. The Service is state run, relying on feeble government funding to enforce hundreds of kilometers of coastal and freshwater fisheries. The Service in the Anosy region of Madagascar has only six employees who use motorcycles to travel around the bumpy, sandy southern coasts. Due to this small staff and lack of resources, inaccessibility to rural fishing villages is one of the main problems for enforcement of regulations in places such as Lac Anony. The main regulations put in place for lake fisheries by the Service include a minimum size requirement of the spaces of nets, such as *harato*, of 30 mm. In addition, crabs caught must be at least 10 cm from head to tail, and fishermen are forbidden to use any sort of poison fishing, whether it is natural (through the use of tree sap), or otherwise (RAZAFIMANDIMBY November 22<sup>nd</sup> 2011). Although no poison fishing was observed at Lac Anony, the management of the size of *harato* nets and crabs is questionable.

The main method of enforcement put in place in the village of Antsovela is the use of *DINA*, or community enforced rules. This means that if a villager sees a fisherman disobeying a regulation, they can have them punished, which commonly includes the burning of their fishing net (President of the *Fokotany*, 2011). For the President of the *Fokotany* of Antsovela, this means keeping an eye out for the use of *harato* nets with spaces less than 30 mm. The use of extremely small spaced nets allows for the capture of young fish, decreasing the population that will reach reproduction age (Cinner, 2011). The President proclaimed, “eliminating the use of small *harato* nets is the most important thing for Lac Anony right now” (President of the *Fokotany*, 2011). When asked if fishermen disobey this regulation, the President said, “Yes, there are most likely some who do”. The effectiveness of the *DINA* is unknown, but most likely weak, action rarely taken for disobedience. In addition, the capture of crabs smaller than 10 cm

from head to tail was observed, however, in the market at Amboasary, most crabs were of a larger size. Capture and consumption of juvenile crabs is likely but only within the limits of the village. Collaboration among the villagers has been challenged not only through these community regulations, but also through a failed Association of Fishing.

In 2004, the Madagascar Minister of Population implemented an Association of Fishing in the village. This association was put in place in an attempt to organize and control the different sects of the fishery: the fishermen, the transporters, the vendors, and the women who salt-dry fish for selling (Ex-President of the *Fokotany*, 2011). Unfortunately, the association was shut down in 2006 due to the high amount of corruption amongst the members and administration (Fisherman 1, 2011). One fisherman expressed his initial excitement when the association was created. He explained how he thought working as a cohesive group of fishermen would improve his catch and income, helping him take care of his 20 children. However, the association was set up so that each fisherman had to put 50% of their earnings in a communal cashbox, which would theoretically go back to them through supplies and resources. The fishermen never experienced this reality, the money either secretly kept by members or eaten up by the administrators of the association. The fisherman interviewed quit the association after six months, fed up with the lack of cooperation among the group. Implementation of a successful association could not only increase resources for fishermen, but also improve management of resources through cooperative techniques and methods. This hope was expressed by the ex-member who said, “I was happy that there was an association, I just wished it would have continued effectively” (Fisherman 1, 2011).

## Discussion

### Comparison of Village of Antsovela: 1953 to 2011

Comparison between the traditional fishing industry at Lac Anony in 1953 and 2011 reveals much growth in the village of Antsovela. Exponential growth in the population and size of the village along with changes within the fishery are observed.

	Population	# Men	# Women	Cultivated Land Surface Area	# of fishermen who only fish	# of fishermen who are also cultivators
1953 (Lamarque, 1953)	64	31	33	8 ha	7	12
2011 (Ex-President of the <i>Fokotany</i> , 2011)	965	387	578	1700 ha	<i>almost no one</i>	<i>almost everyone</i>

Figure 6: comparison between the population and size of the village of Antsovela in 1953 and 2011.

This table reveals that the population of Antsovela has increased 15 fold over the course of 58 years, an average growth rate of 1.7% each year. The number of people in the village who are just fishermen has decreased to practically nothing, with almost everyone also cultivating fields. This stands in contrast to only 18.75% of the population participating in both activities in 1953. This change is reflected in the 1,692-hectare increase in surface area used for crops.

Pierre Lamarque also noted that Antsovela was the only village of the five fishing villages surrounding Lac Anony in 1953 that had habitants of Tanosy decent. Although today

the majority of the village is of Tandroy decent, the possibility of continued Tanosy culture is discussed.

### Comparison of Fishing Methods: 1953 to 2011

*November 11<sup>th</sup>, 2011:*

*I saw a man walking back to the village from the lake with a simple fishing rod in his hands. Shocked, and excited to learn about the method I kept expecting to see on Lac Anony but never had, I ran after him, my translator trailing behind. "Salama! Azafady<sup>14</sup>," I cried breathlessly. Once he paused and greeted me back, I began rattling off the questions I had for him to my translator: "Was he fishing with his pole on the lake? What did he catch? How often does he fish with a line and pole?" My translator conversed with him for a second and then turned to me and said, "Um, he wasn't fishing on Lac Anony, but a little ways away at a small water source, and he used up all his bait and didn't catch anything." After a short pause to absorb what I just heard, I replied, "Oh, sorry about that, and misaotra<sup>15</sup>."*

- Corinne Haynes

According to Pierre's *Monographie de la Pêche au Lac Anony*, the four methods of fishing utilized by fishermen in 1953 included pole fishing, net fishing, trap fishing and group net fishing, most likely through the use of a type of beach seining (Lamarque, 1953). Net fishing, both solitary with the use of *pirogues* and as a group through the use of *bekobo*, continues to exist today. However, pole fishing has become almost non-existent on the shores of Lac Anony near Antsovela. In addition, although the use of *vovos* and *takebas* are a sort of trap fishing method, they are much different than the traps used in 1953. As opposed to nets for cages, the fishermen used double hooked traps, called *fouines*, that they plunged into the water to catch large crabs, fish and shrimp. The fact that Lamarque studied all villages surrounding Lac Anony, and not just Antsovela, must be taken into consideration when comparing fishing methods because they may vary from location to location.

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<sup>14</sup> "Hi! Excuse me,"

<sup>15</sup> thank you



	% of fish caught (Lamarque, 1953)	% of fish caught (2011)
Group net fishing ( <i>bekobo</i> )	78%	82.7%
Individual net fishing ( <i>harato</i> )	12.2%	10.6%
Pole fishing	4.4%	0%
Trap fishing (use of <i>fouines</i> )	5.4%	0%

Figure 7: comparison of methods used in 1953 to today based on percentage of number of fish caught

This chart reveals *bekobo* and *harato* nets to be the most effective methods in both 1953 and 2011, the percentage of fish caught by *bekobo* nets increasing slightly from 78% to 82.7% and by *harato* nets decreasing from 12.2% to 10.6%. Pole fishing and trap fishing with *fouines* were both not observed in 2011, and the two other methods utilized today, *vovos* and *takebas* were not discussed in Lamarque's study.

Lamarque discovered that the majority of fishermen “*a son mode de pêche*”<sup>16</sup> that they stuck to day after day: a trait that was also observed in this study (Lamarque, 1953). Each fisherman and family has their respective daily methods and fishing schedule, whether it be pulling in a *bekobo* for a couple hours in the morning, or setting off in the lake with *takebas* each day at 10 AM. In addition, Pierre Lamarque noted that net fishing seemed to be a Tanosy tradition and pole fishing seemed to be more of a Tandroy tradition. As a result, he found more net fishermen in Antsovela than in any of the other villages around Lac Anony. Today, net fishing both through the use of *harato* and *bekobo* nets are popular methods utilized by fishermen at Antsovela. The lack of pole fishing and the high percentage of net fishing in the village today could reveal the continued influence of Tanosy tradition, even though the village has become inhabited almost entirely by Tandroy people. However, one may wonder if it is simply due to geographical differences around the lake, and not “*une question d’usages raciaux*”<sup>17</sup>, as Pierre concluded, that there is a variance in methods used (Lamarque, 1953).

<sup>16</sup> “his own style of fishing” (translated from French by the writer)

<sup>17</sup> “a question of racial usage” (translated from French by the writer)

Antsovela's location may be more suited for net fishing, while other shores around the lake may be better for pole fishing.

### Comparison of Species Identified: 1953 to 2011

Pierre Lamarque identified 38 different species within Lac Anony, including one species of crab and one species of shrimp, *orandava*, which both continue to thrive in the lake. Of all the species he identified, it appears that 11 exist today as well. 10 of the 11 were identified on site at Lac Anony, and one species, *halalaza*, was identified in the market at Amboasary, but not at Antsovela. The possibility of the change of species names, and the existence of multiple names for one type of fish could mean that more than the 11 continue to exist in the lake today. Of the

Species Identified both in 1953 and 2011
<i>Angera</i>
<i>Foza</i>
<i>Halalaza</i> *
<i>Herotse</i>
<i>Malaly</i>
<i>Matsitsoke</i>
<i>Menahariva</i>
<i>Orandava</i>
<i>Saifotsy</i> **
<i>Sandry</i>
<i>Votsoboly</i>
* identified at the market at Amboasary in 2011, but not at Antsovela
** name in 1953 was <i>salifotsy</i>

four species that Pierre identified to be the most abundantly caught by fishermen, two were found to exist today: *angera*, the number one most caught fish in 1953, and *sandry*, the number four. In this study, *angera* ranked 9<sup>th</sup> out of the 34 species caught by fishermen at Antsovela, and *sandry* ranked 18<sup>th</sup>, with only five specimens recorded. It is also important to note that different times of the year result in higher

catches of specific species. For the *angera*, the primary season for good catch falls during the months of February and March (Male Villager, November 14<sup>th</sup> 2011). This study, conducted during the month of November, found low catch rates for the *angera*, a total of only 42 specimens recorded. However, multiple fishermen expressed the high demand for the famous

endemic fish of Lac Anony, it's taste cherished by those in both the rural villages and the city of Amboasary. High demand for the fish could mean it is being overexploited within Lac Anony, contributing to the disparity between the *angera* population discovered by Lamarque in 1953 and today.

### **Concerns for the Fishery at Lac Anony**

*With a chuckle she said to me, "Whatever you do, don't outlaw our bekobo nets!"*

- Woman living in the region of Lac Anony to Corinne Haynes during discussion of this study

Antsovela is a growing village with primarily one livelihood within its limits: fishing at Lac Anony. Although the fish within the lake are currently at high levels thanks to the recent opening of the *vinany* separating it from the sea, and the fishermen are experiencing productive catches, selling fish brings in an extremely low income. For most of the parents in the village, ensuring that their children continue their education is a top priority because they do not wish for them to carry on as poor fishermen. In the words of one villager currently studying in Amboasary, "the solution is to educate children so they can find better work" (Male Villager, November 4<sup>th</sup> 2011). However, as stated before, this is a challenging feat for children born and raised in the poor village where fishing is such a part of their life. It is the difficult access to higher education that has caused the fishery to continue in a similar manner as it did over 50 years ago. Little improvement in fishing techniques has allowed for tradition to carry on from generation to generation, and the fishery to continue with poor income.

For many fishermen in Antsovela, the answer to their lacking income could be access to better fishing supplies such as nets and nylon line. However, few people desire to actually change the methods they have been using for generations. The *bekobo* and *harato* nets have been working well for them for decades. A main concern for the industry is the detrimental

damage these traditional methods may have on the lake's already pressured resources. As discussed by Geoffrey G. Shester, "the collateral impacts of fisheries are influenced by the nature of the fishing gears used and the susceptibility of the species and habitats where they are used" (Shester, 2011). In Lac Anony, the habitat and species are all susceptible to overexploitation due to the closure of the lake and the traditional methods used. The use of beach seining, in this case through the use of *bekobo* nets, is academically recognized as a harmful fishing gear "that can severely damage habitat and capture a high proportion of juvenile fish, diminishing reproductive potential" (Cinner, 2011). In addition, enforcement of regulations against harmful nets and the catch of juvenile species is practically non-existent. As a result, depletion of resources is something the villagers have observed for decades now, many expressing decreased quantities of fish as their main concern for the traditional industry. If the lake had not opened to the sea this past February, the populations of shrimp and some fish species would be much smaller, placing increased difficulties on the families surrounding Lac Anony. In addition, the flourishing population of Antsovela is only adding to the pressures on the lake, more people fishing than ever before.

Another factor adding to the strain on the resources of Lac Anony is a continually dry climate. When asked about the change in catch rates on the lake, the eldest villager spoke about rainfall, saying, "When it rains, there are lots of fish. When it doesn't rain, there are less fish" (Eldest of Village, 2011). This theory expresses the effect climate change has on the lake. Not only is Lac Anony frequently closed off from its source, the ocean, but also lack of rainfall is contributing to the drying of the basin, decreasing fish populations. In 1953, annual rainfall in the region was 459.6 mm/yr (Lamarque, 1953). This dropped to an average of 451.3 mm/yr in the city of Amboasary during the years of 1992 to 1997 (Madagascar, 2003). In 2006, the

district of Amboasary-Sud experienced especially dry conditions, drought striking the region causing food insecurity (MARENJAKA and ELISA, 2009). The possibility of this trend continuing is likely as the global climate continues to change.

Concern for the livelihoods of the fishermen at Lac Anony has led to the proposal of a manual opening of the *vinany* separating the lake and the sea. If the dunes were to be opened, there would be a constant influx of fish into the lake. The quantities and size of the species would theoretically prosper, increasing the catch rates and income of fishermen in the area. According to the current Director of fishing in the Anosy region, Chrysostophe RAZAMIFIMANDIMBY, allowing for the opening would not only increase the livelihoods of the fishermen, but also supply jobs to locals who would manually shovel out the dunes. He explained that this is a possibility that has been discussed, but the resources and reality of it are not currently accessible (RAZAMIFIMANDIMBY, November 22<sup>nd</sup> 2011). Although this opening could potentially help the fishery, the environmental effects could be monumental. In 2004, the proposal of a manual opening of the *vinany* by PNUD (Programme des Nations unies pour le développement) was never realized due to the influence of the international NGOs FAFAI and Rapide. These two organizations attempted to do the opposite, planting sisal and other rugged native plants on the dunes to hold them in place. This activity, financed by Madagascar Minister of Water and Forests in 2006, worked to minimize the amount of sand eroding into the already low water basin of Lac Anony (MARENJAKA and ELISA, 2009). A complete manual opening of the dunes could lead to severe erosion, increasing sedimentation within the basin and eating away at the land that many villagers currently call home. In addition, the influx of certain species over the course of many months could completely change the habitat of the lake, the shrimp and fish that the villagers know well disappearing. The expanse of

negative environmental effects is unknown, and the question of whether the manual opening is necessary remains unanswered. Lac Anony already has a natural rhythm of restocking its resource supply, but as a closed off basin in one of the driest regions of Madagascar with a constantly increasing population fishing within its limits, is the lake fishery reaching its tipping point? Or will nature continue to mediate the most important resource for the people living at Antsovela and the seven other surrounding villages? This is the true concern and main mystery of Lac Anony.

### **Conclusion**

The most fundamental aspect of the lives of villagers at Antsovela is fish. They fish for food, they fish for money and they fish for entertainment. Young children know the names of each species found in Lac Anony, all of them growing up learning how to bring in catch. Toddlers run to the *bekobo* nets once they have reached shore, their little fingers swiping *sia sia* out of the collection buckets to play with. Families chant songs, smiles spread across their sweaty faces as they sort out their daily catch. The fish in Lac Anony are their entire life, and continued pressure on these resources threatens to destroy all that they know.

Antsovela is a thriving rural village in Madagascar, its population growing 15 fold over the past 58 years and its education level higher than many other villages of the same economic status with over half of the children seeking a higher education. However, the families continue to face increased poverty, relying on the traditional fishery at Lac Anony to bring in a meager income. The importance of the aquatic resources on the lives of the villagers is monumental, and although continuing to increase education and finding alternative jobs is a strong possibility for

amelioration of their livelihoods, fishing is deeply embedded in their lives. It would take generations for the village to move away from the traditional fishing techniques they have been using for over 50 years. Comparison of the traditional industry from 1953 to today reveals that little has changed in terms of methods utilized by the fishermen, large nets (*harato* and *bekobo*) being the most effective and as a result the most common. However, the species caught has changed dramatically, the most commonly caught species today being entirely different from those caught in 1953. In addition, the quantities of high demand fish, such as the *angera*, have decreased drastically from 1953 to today, the continued exploitation of the species leading to degradation. The aquatic resources of the lake have and will continue to change both through natural and anthropogenic factors, placing pressures on the already poor fishery.

These fishermen are stuck in what J.E. Cinner describes as a *social-ecological trap*. He defines these traps as “situations when feedbacks between social and ecological systems lead toward an undesirable state that may be difficult or impossible to reverse” (Cinner, 2011). The fishery at Lac Anony is trapped in a cycle in which nature controls the precious livelihoods of the villagers and a lack of cohesive development keeps them from finding sustainable usage of the resources. He explains further, “missing or weak institutions, interactions between poverty and resource use and the use of specific technologies” all “drive the system toward an undesirable social-ecological trap” (Cinner, 2011). Although the village of Antsovela has seen some aid in years past, its lack of continuation has kept the fishery at a standstill. The rural village does not have the resources or cooperative capabilities to keep developmental structures put in place by the state running. In addition, they continue to use traditional fishing methods due to habit, ease and lack of money and access to find newer techniques. The pressure their

rustic methods coupled with the increasing population is putting on the lake feeds into the social-ecological trap.

An added stress to this cycle, as stated before, is the general fragility of lake resources. As explained by Chrysostophe RAZAMIFIMANDIMBY, fish species in lakes are more sensitive to change than those in the sea because of the smaller size of the ecosystem. This is definitely the case with Lac Anony, its ever-changing relationship with the sea allowing for rapid fluctuation between periods of prosperity, and periods of extremely low resources. In addition, an increasingly dry climate is contributing to a decrease in fish in the lake. According to the current President of Antsovela, one of his main concerns for the fishery is the varying quantity of fish in the lake. The lack of consistency of the lake resources decreases the security of the fishermen's livelihoods; they never know when nature is going to restore their precious supply.

Preservation of livelihoods is a moral obligation, especially in Madagascar, one of the poorest countries in the world. The question of how to not only maintain, but also improve the lives of rural villagers like those in Antsovela is constantly debated. Cooperation is key, among the government, international aid, and the villagers, but finding the perfect combination of control over livelihoods is a challenge. The most important step required of Antsovela is continued education. Not only does education open the doors to new possibilities for young people, it can help them understand the pressures and cyclical nature of Lac Anony. Once the villagers understand the main concerns of the lake resources from a scientific standpoint, solutions can be found from within the community. In addition, management of the lake resources from a governmental standpoint through the Service of Fishing requires increased collaboration with the villages. Relying on one Service to control a huge tract of fisheries is not only difficult from a resources standpoint, but also from a cultural standpoint; each traditional



fishery varies greatly in methods and lifestyles, individual attention required for the sustainability of each one. Increasing the size and resources of the Service and transforming the management to a more localized approach would improve regulation of the lake's resources.

Another important component of the sustainability of Lac Anony is the aid of NGOs. A *co-management* approach must be utilized; decisions such as whether or not to manually open up the *vinany* must be decided as a collaborative effort among the multiple sectors. Evans describes this approach as “the sharing of responsibility and authority between the state and resource-users but often involves collaboration between a variety of stakeholders, including different government agencies, [and] non-governmental organizations” (Evans et al, 2011). International aid is not only encouraged by scholars, but also strongly desired by the villagers. The corrupt nature of the Malagasy state has decreased involvement of foreign countries in recent years, large international organizations unwilling to work in conjunction with the government. As a result, the humanitarian aid of smaller, more localized NGOs could be monumental in the development and preservation of rural villages such as Antsovela, giving the villagers the resources and hope they need to find an escape from their social-ecological trap.

Lac Anony is an especially unique fishery, it's geographical situation with the ocean contributing to the challenges and insecurities of the fishermen in the area. Management and development of the fishery is imperative for its survival, transformation to localized approaches important for sustainability. Increased study of the area could provide further insight to the pressures on its aquatic resources. Surveys of fishermen in all of the surrounding villages would give a more complete idea of the lake's species and catch rates. In addition, weighing and measuring of fish brought in by fishermen would provide information about the change in size of products caught, another important indicator of resource depletion. Regardless, this study looked specifically at the village of Antsovela, providing a charismatic window into the dynamic fishery at Lac Anony as a whole.

## Annexes

### Annex A: Survey Questions for Fishermen

Date:

Time:

Species Caught	# of Specimens

Method utilized:

Amount of time the method was used:

### Annex B: Survey Questions for Vendors

Date:

Time:

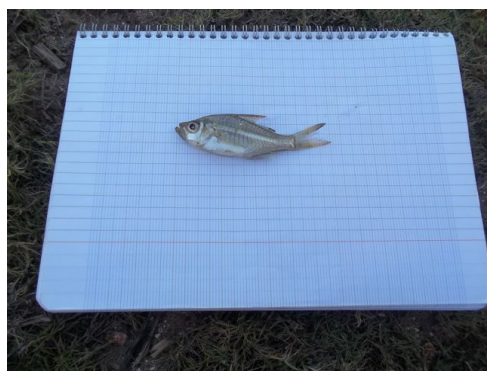
Species Sold	Cost

Origin of Fish:

Transportation process to market:

# Annex C: Index of Species Identified at Lac Anony<sup>18</sup>

## Edible Fishes:



Ambasy



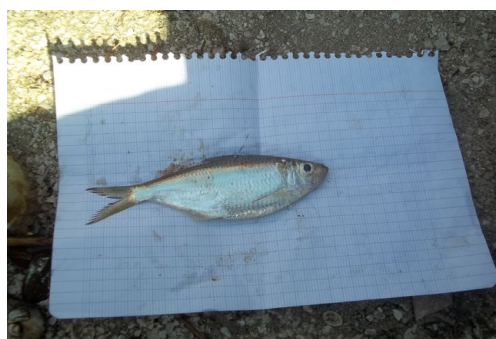
Ambotsoke



Antserake



Angera



Apine



Bohaky



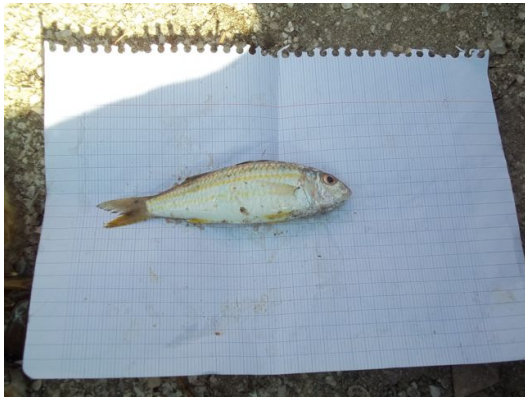
Famatasindriky



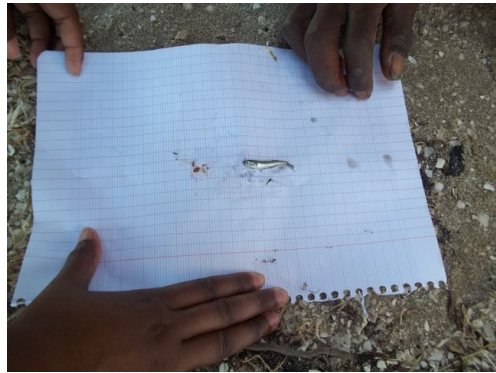
Famokombato

<sup>18</sup> This is not an exhaustive list of species found in Lac Anony, but an index of the species encountered during 12 days of research in Antsovela. One species, *saifotsy*, was also identified but a picture is not available for this fish.





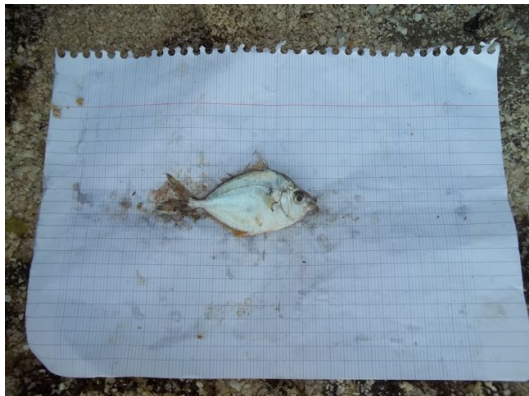
Fiam-batagno



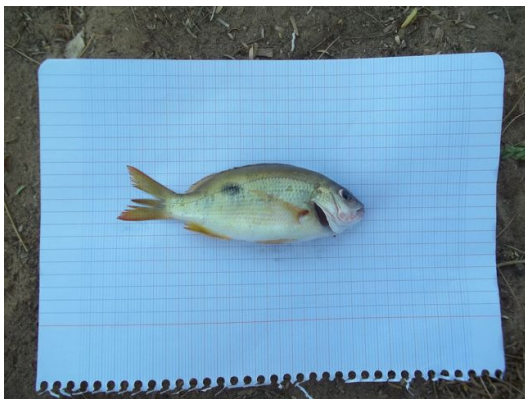
Gdihy



Herotse



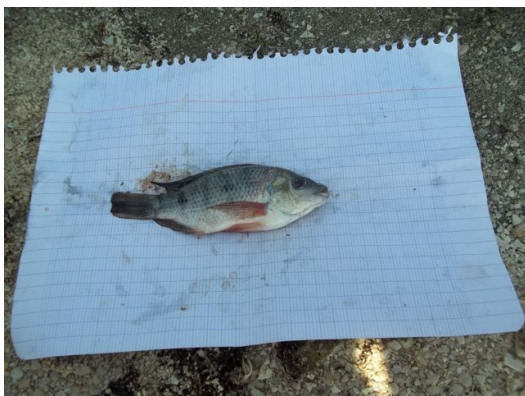
Malaly



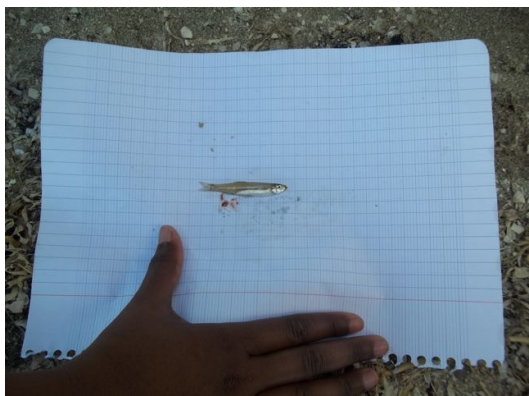
Maliobobo



Matsitsoke

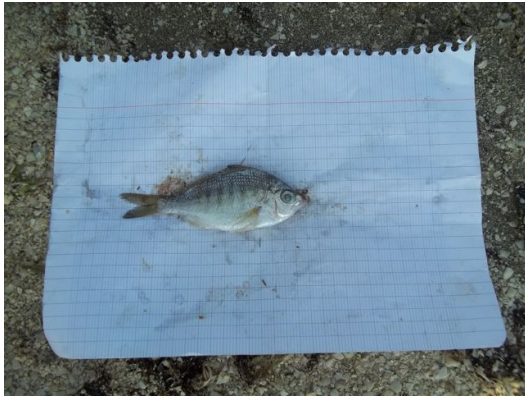


Mazy



Menahariva

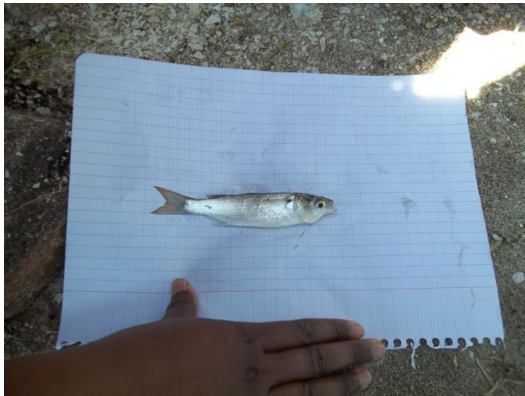




Sandry



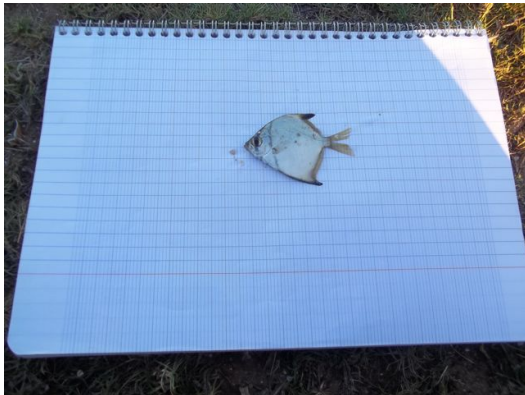
Sia Sia



Sidaky



Taimboay



Takimbaky



Tandaly



Toho



Tovy



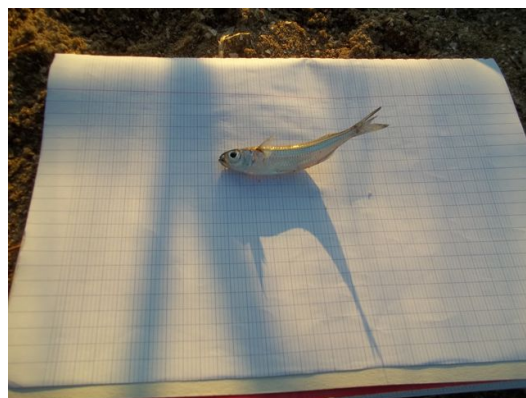
Tsimatebango



Varirilometse



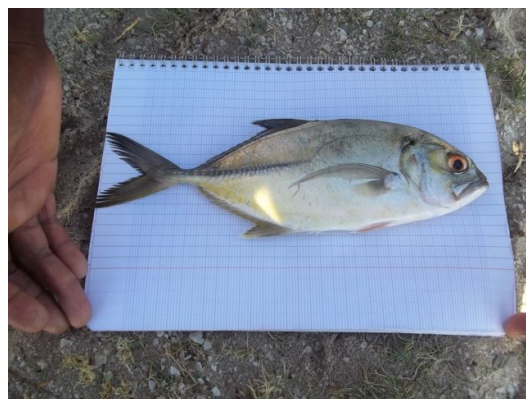
Vay



Vily Maso



Votsoboly



Zanapargne



Other Edible Species:



Ambolo



Foza



Horita

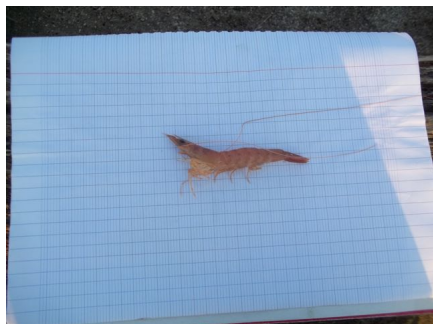
Shrimps:



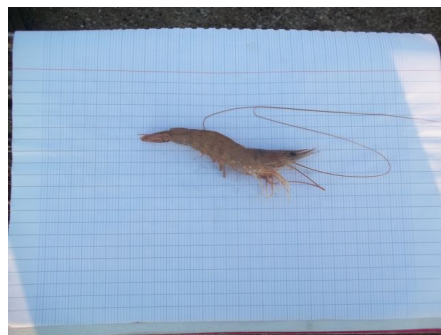
Orampasa



Orandava



Oramena

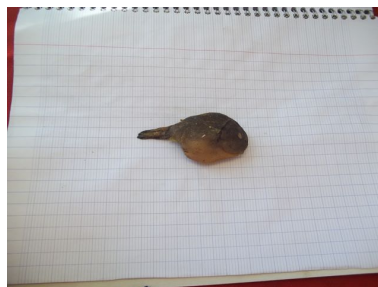


Siskidava

Non-Edible Species:



Lalevo



Bopana

**Annex D: List of Species Sold at the Market at Amboasary and their Respective Costs**

<b>Species</b>	<b>Average Cost</b>
<i>Antserake</i>	200 Ar/cup
<i>Apine</i>	733.33 Ar/group of fish <sup>19</sup>
<i>Bohakoe</i>	1,000 Ar/group of fish
<i>Foza</i>	200 Ar/crab
<i>Gdihy</i>	200 Ar/cup
<i>Halalaza</i>	500 Ar/fish
<i>Maliobobo</i>	1,000 Ar/group of fish
<i>Mazy</i>	1,000 Ar/group of fish
<i>Menahariva</i>	400 Ar/cup
<i>Orampasa</i>	4,000 Ar/kilo OR 600 Ar/group of shrimp
<i>Orandava</i>	300 Ar/group of shrimp
<i>Saifotsy</i>	800 Ar/group of fish
<i>Sandry</i>	1,000 Ar/group of fish
<i>Sidaky</i>	100 Ar/group of fish
<i>Sihotsoke</i>	1,000 Ar/group of fish
<i>Takimbake</i>	500 Ar/cup
<i>Tandaly</i>	1,000 Ar/fish
<i>Vily Maso</i>	259 Ar/cup

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<sup>19</sup> A group was 5-8 fish



### **Annex E: Glossary of Malagasy Terms**

*Ariary* – Malagasy currency

*Azafady* – excuse me

*Bageda* – Malagasy sweet potato

*Bekobo* – type of beach seining net

*DINA* – community implemented regulations and enforcement

*Fady* – Malagasy taboo

*Fokotany* - administrative district

*Fouine* – type of double-hooked fishing trap utilized in the 1950s on Lac Anony

*Harato* – type of fishing net placed and removed from the lake with the aid of a pirogue

*Hofa* - bait

*Lambaoany* – traditional fabric worn by women

*Lolodranos* – spirits that are believed to dwell in the sea, wreaking havoc on fishermen

*Marché* – French word for “market”

*Misaotra* – thank you

*Pirogue* – traditional hollowed-out canoe used by fishermen

*Salama* – Malagasy greeting

*Tsy misy* - nothing

*Vazaha* – white foreigner

*Vinany* – the dunes creating a barrier between Lac Anony and the Indian Ocean

*Vovo* – cages used for catching shrimp and some species of fish

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Note about personal interviews:

All interviewees were notified of the purpose of this study and were able to give their personal consent to be questioned. In addition, all direct quotes from interview sources are translated in the writer's own words first from Malagasy into French through the use of a translator, and then into English from French by the writer. As a result, they are not the exact words of the informants, but the ideas generally expressed.