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TRADITIONAL KNOWLEDGE, BELIEFS AND PRACTICES ON COLLECTION OF LAKE FLIES (CHAOBORUS AND CHIRONOMUS SP.) AND THEIR IMPLICATIONS ON FOOD SECURITY

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ABSTRACT

Lake Flies are edible insects with the potential of contributing to food security in that they are an alternative protein and micronutrient food source in freshwater lake regions. The main challenge in exploiting the lake flies is difficult in the collection. This study was conducted to identify sustainable traditional collection practices and forecasting techniques of lake flies and was implemented in Rusinga and Mfangano Island in Kenya. The ethnographic study employed multiple methods of data collection: focus group discussion (FGD), observations and interview schedules. 5 (3 female and 2 male) key informants were selected for interview schedules aged above 60 years. 48 (19 female and 29 male) participants took part in FGDs they were divided into 8 sets each containing 6 participants and an age range between 18 to 40 years. Open data kit (ODK) software was used for data collection while analysis was conducted via thematic analysis framework using Nvivo version 10 software. Questions were administered on traditional lake-flies emergence forecasting, collection techniques and devices. The emergence of lake flies is determined by moon sightings, the presence of strong winds and the rainy season. Lake flies can be collected: mid-air flight mode, bushes along the shore and night operations using a light source (bulb, touch). Lake flies are collected using traditional tools: a woven basket with a stick handle, pots, a plastic basin and a woven basket with a stick attached. Cultural myths associated with lake flies included: marriage partner/business customers' attraction. Uses include libido enhancement, remedy for sickness and good fish harvest indicator. In conclusion, lake flies have the potential to contribute to food and nutrition security as affordable and locally available alternative protein and micronutrient source.

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INTRODUCTION

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Due to the rise in population from 6.9 billion in the year 2010 to 8

billion in the year 2020 and projected to increase to 9 billion by year 2050 around the world, this increasing population has created high pressure on land and food which is limited to cater for this growing population (United Nations, 2019). This in part explains the poor nutrition trends around the world mainly in Sub-

Saharan Africa (SSA), South-Eastern Asia and Western Asia. Micro-nutrient deficiency has caused hidden hunger and malnutrition leading to chronic diseases like stunted growth, obesity and retarded brain development (Lartey *et al.*, 2018) paving the way for non-communicable diseases. The increasing population comes with an increase in food demand, pressure on land for industrial use, and residential and agricultural land.

Protein remains to be an expensive nutrient and the conventional sources are declining due to population increase and demand for food (Maillot *et al.*, 2007). Over-fishing and capturing immature fish are one of the challenges causing depletion of fishery resources. About 90 percent of the fish harvested is below the mature stage and the current trend of harvesting is at 500,000 tons per annum. Additionally, the Nile perch harvested is below the mature stage and the mature size of Nile perch is 50-85 centimetres (Njiru *et al.*, 2008). This will lead the mature fish not able to reproduce to ensure there is sustainable availability of fish in the lake, this is the reason there has been a decrease in the catch per boat and gear over the years indicating a decrease in the fish stocks in Lake Victoria (Crean and Geheb, 2001). In addition, plant protein sources are inadequate to supply to the world population and climate change is negatively contributing to agriculture by producing low yield, therefore there is a need to research further and come up with well-adapted plant protein crops to the changing climate which will sustain high yield. Sustainability of protein can be maintained by alternatives like cultured meat, precision fermentation and insect sources, of these the least affordable and locally available is insect source (Weindl *et al.*, 2020).

Entomophagy is as old as man history from eighth century, the consumption of insects was practiced on culture basis which was influenced by the peoples believes. Entomophagy is depicted in history from diverse faiths like Jewish, Islam, Christianity and different tribes (Food and Agriculture Organization of the United Nations, 2013). There are around 1000 insect species of insects which are consumed around the world, of which 524 species are consumed in Africa (van Huis, 2003). Insects have also been used traditionally as medicine for both humans and animals, they have and are potential can be used as alternative animal feed. There are social and anti-social insects, the social ones are the species which live in colonies like termites, ant's

and bees. They express three characteristics of socialisation, division of labour and overlap of generations. These social insects vary in morphological and anatomical structure depending on their specialised functions in the colony (Britannica, 2018).

Mostly Insects emerge during the rainy season to breed. Termites emerge mostly during the rainy season as the male and female termites, fly to start new colonies. Moths as well begin to emerge during the rainy season to breed (Rentokil, 2021). Aquatic insects are also triggered to emerge due to the presence of moon sightings in the sky (Corbet, 1964).

Insects are collected from the wild via several methods: use of light, which is when they are lured into light and then collected and another light technique is the use of improved blacklight to lure insects whereby a light source is placed behind a sheet to attract insects at night and they are collected on the bottom in containers with killing chemical like cyanide and ethyl acetate (Mississippi State University, 2021) and (van Huis, 2003). Usage of sound, this is whereby insects are collected by listening to tree trucks to the sound made by nibbling of beetles and the sound made by crickets. Another method is collecting at resting places where insects have congregated in large numbers like a heteropterous insect, *Natalicola delegorguei* which is harvested at end of the rainy season (van Huis, 2003). Collection using smoke, the insects are exposed to smoke when harvesting them like a collection of caterpillars they make grass smoke just below the mopane tree and then the insects fall to the ground where they are collected. Mostly these collection activities were conducted by women. Glue is used to collect insects as well by applying it to a stick and inserting it into a hole where insects are or by collecting them from tree branches. These collection methods use several collection devices: hands, nets attached to pots, sticks with glue, basins and pans.

According to van Huis (2016), many insect species are rich in protein, fatty acids, vitamins and minerals. Insects which are edible mostly meet the requirements of the world health organisation for amino acids and essential amino acids. These edible insects have protein content which is comparable to conventional meat sources. Fat content is another nutrient composition that edible insects contain, the fat content is usually higher than that of dairy products. They are also rich in micronutrient content like zinc and iron.

According to van Huis (2016) insects can be used as human food and animal feed. They can be used as alternative protein, micronutrient and fatty acids sources in animal feeds. This creates affordable feed which leads to increased animal production, thereby creating commercial value for insects.

In the Lake Victoria region of Kenya, there are two edible species of lake-flies *Chaoborus* sp. and *Chironomus* sp. These species are used by the local communities as food, traditional medicine, and attraction of customers for business or love partners and they are associated with myths (Ayieko and Oriaro, 2008). Lake-flies are an alternative protein and micronutrient source for humans and feed to animals. They have a high protein content of 62%, low-fat content of 3.9% and minerals of 18% (Okedi, 1992). Lake-flies are used by humans as food to feed their malnourished children and also, they are key in people's diets (Ayieko and Oriaro, 2008).

According to Hilsenhoff (1966) when lake flies emerge the males form columns which females enter and mate mostly this occurs morning hours, once mating has occurred eggs are laid on the water surface and they absorb water, swell and sink to the bottom of the lake. The newly hatched eggs larvae are fed to many fish and one particular species of leech. When the larvae pupate and emerge, they fly weakly with the wind and gradually accumulate at the beach (Cplai, 2013) and (Hilsenhoff, 1966). Terrestrial animals like birds feed on the insect as well when they emerge on the water surface and when they fly on land (Allison *et al.*, 1996). These lake flies are an important indicator to show whether or not the water is polluted therefore presence and the number of lake flies are used to determine the extent and magnitude of pollution (Porinchu and MacDonald, 2003). Lake flies have economic potential in that some of their benefits can be exploited for commercial value for instance they can be used as a medicine to enhance libido and maintain pregnancy in women. Another commercial value is that they can be used in livestock production as medicine (Ayieko *et al.*, 2010).

Traditional knowledge has the potential to ensure food security by transmitting to the current and next-generation knowledge to manage and conserve the ecosystem by promoting the biodiversity which supports life in their community thereby ensuring sustainable use of resources (International Fund for Agricultural Development (IFAD), 2016). These lake-flies are traditionally harvested using locally made woven

basket attached to a three-meter stick, home-pans and baskets (Ayieko *et al.*, 2010) and (Cplai, 2013). Lake-flies are stored via several methods: sun-dried, dip-fried lake-fly biscuits (Cplai, 2013). Over the years traditional knowledge has been degrading due to changes in consumers' perception of food and traditional values which could have negatively affected indigenous people's identities leading to unsustainable use and management of local resources resulting in unbalanced functioning of the ecosystem (United Nations, 2019). There is a need to promote entomophagy even though most the insects are seasonal and enhance consumers' perception of entomophagy and value addition to insects to improve insect consumption (Pambo *et al.*, 2016).

People along the lake regions collect these lake flies via several traditional techniques but it has been noted that it is difficult in the collection the insect and this study was conducted to identify sustainable collection practices which increase the availability of the insect (Ayieko and Oriaro, 2008). This paper discusses the traditional collection and forecasting techniques, believes and uses associated with lake flies and recommendations were made on collection methods which ensure efficient and effective harvesting to ensure adequate catch of the underutilised lake flies that are available in bulk at household level to ensure food security.

MATERIALS AND METHODS

Study area

The study was conducted along the Lake Victoria region and focused on the edible lake flies (*Chaoborus* and *Chironomus*). The area of study was in Homa-Bay County and specifically in Mfangano with GPS coordinates Latitude: 0° 27' 59.99" N Longitude: 34° 00' 60.00" E and Rusinga Islands with GPS coordinates of Latitude: 0° 23' 59.99" N and Longitude: 34° 09' 60.00" E in Suba North Sub-County of Nyanza Region, Kenya. In Mfangano data was collected from Kitenyi, Wamai and Wakinga Villages. In Rusinga from Wanyama, Kaswanga and Kamasengre villages. The study two study areas were selected because lake flies emerge and are collected in these areas and are used as an alternative relish. There are three main rain seasons peak the first one occurs in March to May, the other one from October to December and the minor one is in July to August to add to this inter-between these main peak rain zones the rain also fall within the other months. The interview

schedule participants were selected on snowballing sampling method this is because they were competent in the collection, processing, consumption and storage of lake flies. Interview schedules participants were conveniently identified by their fellow elderly participants who took part in the study. Focus group discussion participants were selected on purposive sampling method depending on their knowledge of lake-flies and their age had to range between 18 and 40 years. The selection of these study participants was guided by a local Agriculture Extension Officer who was well informed of communities that collect and eat lake flies.

Data collection

The ethnographic design was utilized, the study involved staying with the local communities before selection of relevant respondents. The informants were selected depending on their knowledge of the Lake-flies. Targeted groups included the youth and elderly people. Observation, focus group discussions and interview schedules were used to collect data. During the study, the participants were accompanied when predicting and collecting the lake-flies. Fifty-three (53) respondents were involved in the study within a span of 7 weeks it was done from November to December 2020. The study employed Focus Group Discussions and Scheduled Interviews with individual respondents. 5 (3 female and 2 male) key informants were selected for interview schedules, these participants were elderly aged above 60 years and had an in-depth understanding of the collection, processing, consumption and storage of Lake-flies. 48 (19 female and 29 male) participants took part in FGDs, these were divided into 8 sets. Each set contained 6 participants and their age range was between 18 to 40 years.

The FGDs participants were selected based on their knowledge of lake-flies collection, processing and consumption. The study utilized observation to monitor the conditions in which lake-flies emerge and to cross-check what interview schedule and FGDs participants information validity on collection methods used to harvest lake-flies in the wild using basin and odheru. Predicting indicators of natural phenomena of rain-fall, and strong winds used by the community to predict emergency of lake-flies.

Each FGD participant's name was replaced with numbers ranging from 1 to 6 and interview schedule names were replaced with alphabetical letters.

Data analysis

All the data collected from the study were transcribed using Microsoft word 2016 and analysed using Nvivo software version 10 to generate codes which were used to construct themes.

RESULTS AND DISCUSSION

Emergence and collection of lake-flies

The study found out that locals use natural weather conditions and lunar periodicity indicators to predict lake-flies emergence:

Lunar periodicity

The study noted that lake-flies emerge from the lake when the moon is half risen or starting to appear. When they emerge from the lake, they form into a cloud which appears sometimes in black or brown. According to elderly participants Sam (Luo word for lake-flies), usually emerges during moon sightings this was in agreement with FGD participant number (1). This is in agreement with the study conducted by Corbet (1964) which noted aquatic insects emerge depending on moon sighting, also Ayieko and Oriaro (2008) noted that the emergence of lake-flies depends on lunar periodicity, in that when the moon begins to appear that is also when the lake-flies also begin to appear. The full moon is one of the traditional indicators used by the locals to determine the emergence of lake-flies. Such appearances and symbols are upheld by the older generations even though the current younger generation does not seem to value the phenomena because they are less knowledgeable about the lake-flies.

Presence of strong winds

Lake-flies emerge from the lake in cloud form and arrange mid-air columns then blown to land by strong winds in the morning and or evening hours, they eventually form mid-air columns to mate. Similar findings by Cplai (2013) of lake-flies forming mid-air columns with the main purpose of mate and strong winds blow them to land or further deep into the lake when they emerge. The study observed that there are four types of winds which affect the lake flies and the local communities distinguish them by name depending on their strength and direction: One Ogingo/Ngamoginyo (is the most powerful wind which comes from Southwest to Northeast of Mfangano bringing lake-

flies) this wind comes from Milingo (a small island close to Mfangano and has no human settlements) direction to Mfangano. The second is Yandha (the second most powerful wind which brings lake-flies from Southwest to Northeast of Mfangano), the third is Komathi (is the wind which takes Sam away from Mfangano) and the fourth is Genya (wind from North to South of Mfangano and has no lake-flies). These winds were stated by one of the elder participants (letter C). When the lake-flies emerge, they are seen as a large blown cloud of smoke in the air, then the wind is their transportation means to reach land, as stated also by participant (letter B). Once the community observes this, they prepare traditional collection tools to catch the lake flies.

Rain season

Sam emerges during the two main rainy seasons which start around March or April for long rains and September or October for short rains. During these seasons the lake flies emerge out of the lake immediately when rains start failing, as reported by participant (letter D). Another elderly interviewee (letter E) commented correlating statement that lake flies came in a large group like birds flying in large numbers and they came from the Uganda side. The emergence of the lake flies in the rain season is similar to the emergence of other edible insects like winged termites, moths and grasshoppers which emerge to breed and start new colonies.

Collection of lake-flies

Sam is collected in three main ways:

Collection from the bushes and lakeshore vegetation

The study noted that Sam can be collected in the bushes when it has emerged from the lake and blown to land by winds. When the lake-flies arrive on land the only thing which makes them not go further away with the wind is vegetation. They settle on the vegetation along the shores of the one deep in the land. Inadequate vegetation causes them to be blown away by the wind. After they land on the vegetation, they are active during the morning and evening hours while for the rest of the day hours they settle in vegetation. According to Cplai (2013), lake-flies are active morning and evening hours after mating in mid-air flights and for the rest of the day hours they rest in bushes/ vegetation. The study noted that it was a norm for lake-flies to be collected and

processed by women only. Each woman is her allocated own space known as a kitimbo (Luo word for a place along the Lake Victoria shores with thick vegetation allocated to a woman for lake-flies collection). The women use local instruments called odheru/ otete/ raungi as in figure 1 (Luo word for a local woven instrument made from papyrus lid to collect lake-flies) or basin to collect Sam from the vegetation, they shake Sam from vegetation into odheru/basin as in figure 2 then smash them together and this technique of collecting from the vegetation/ bush collected together with impurities like leaves and other organisms. This was according to elderly participants claimed that Sam was mostly collected by women and they were allocated specific places of collections called kitimbo. Only women were involved in collection and processing since men spend their time mostly fishing. Another elderly participant (letter A) also said women were the ones responsible for collecting lake-flies using a traditional instrument raungi and processing. The point that it was women's responsibility to collect and process lake-flies is also confirmed by one of the FGD participants (number 2). Similar studies conducted by Ayieko *et al.* (2010) found that lake flies are collected using traditional instruments of basins/ pots/ woven baskets which are whirled in the air or lake flies are collected from bushes. Similar findings by van Huis (2003) enlightened that the collection of insects was commonly done by women.

Mid-air flight collection

Lake-flies can be caught as they are flying mid-air by whirling in the air olungro as in figure 3 (Suba word for local instrument used to collect lake-flies made of papyrus lid woven basket with a stick attached). The study noted that whirling the instrument had the advantages of catching Sam without any impurities, easy to operate and convenient to construct with plenty of raw materials available for construction. The disadvantage is that the net-shaped is highly rigid. This agrees with the elders interviewed letter (C), another FGD number (2) also states similar findings. According to Ayieko *et al.* (2010) found similar findings that lake flies are collected using a woven basket which is attached to a three- or four-meter stick when the lake-flies have emerged.

Use of light

Another technique of collecting lake-flies is by usage of light. It was noted that these insects are attracted to light sources during the night. Similar findings were found by Orkin (2021) where lake-flies were also noted to be attracted to light sources in large numbers at night and van Huis (2003) also observed that insects have the feature of being attracted to light sources (bulb, touch) making it convenient to collect them.

The study observed that the disadvantage of this is that they are only a handful and costly to maintain light for the collection of lake-flies. Over time the method has been upgraded to the collection using blacklight to harvest insects by luring them to sheets which are fixed with light sources. The use of light needs to be upgraded to this modern technology to improve collection effectiveness.



Figure 1. *Odheru*.



Figure 2. Basin being used to harvest lake-flies

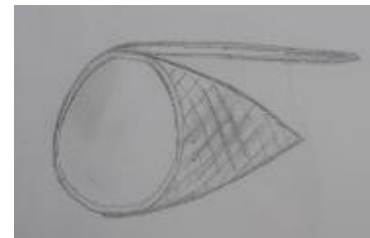


Figure 3. Sketch of *Olungro*

Myths associated with lake-flies

Marriage partner or business attraction

The study noted that lake-flies can be utilized as a charm in business for instance to catch more fish by the local fishermen and people who are seeking to find love partners use them as a charm to attract the man or woman of their desire into their life. According to the participant (number 2). This illustrates vividly the traditional value of lake flies to the local community which corroborated with some of the findings of Ayieko and Oriaro (2008) who noted that lake-flies are utilized as a love charm to attract love partners and used in business world to attract more customers to an enterprise. The study further narrated that lake flies were traditionally believed to have these superstitious properties because it can to attract black ants. Another participant (number 3) interviewed stated the same point this just indicates how further research is also needed for the traditional and underworld value of lake-flies.

Superstition of the source of lake-flies

The study noted there are superstitious beliefs of where the lake-flies originate from, some believe it comes out from Migingo island which is close to Wemba island. They describe the place to very thick and milky colour waters, there are even strange voices which have no source echoing. This was according to one of the FGD participant (number 4) and another FGD participant (number 5). Even the elderly participants interviewed were not able to pin point exactly the source of lake-flies from the lake, which means there is no actual point from the lake where these insects emerge from.

Uses of lake-flies

Libido

The study noted that local communities perceive that consumption of lake flies enhances man-power, in that he gains more sexual energy and is even able to have many children with several wives. As reported by interviewed participant (letter A) and another FGD participant (number 1). These findings are in agreement with a study done by Ayieko *et al.* (2010) which found that lake-flies can be utilized for medicinal purposes to increase libido in men and aid in the retention of

pregnancy in women. Nowakowski *et al.* (2022) found that entomophagy has several benefits as medicine: potential to improve sexual desires, enhance the quality of semen in men, increase fertility, prevent male early ejaculation which clearly supports the point why most men of old were able to have several wives and be able to perform in bed and be fruitful.

Remedy for sickness

Local communities believe that lake flies can be used as a home remedy to treat certain diseases. The study took note that the local communities treat stomach-ache and even some skin with constant consumption of lake flies. This is similar to the interviewed participant (letter C) and correlates with the findings of Ayieko *et al.* (2010) who noted that lake-flies are not just food but also have medicinal value to the consumer.

Good fish harvest

It was noted that lake-flies are used by the local fishermen to have a huge harvest of fish, in that they visit the local herbalist or witch doctor who instructs them to bring lake flies to make a charm to enable them to have a large catch. This was as reported by participant (letter A). The emergence of lake flies also symbolizes a good catch of fish in that as they are blown to land by strong winds some fall along the water surface where they are easily eaten by fish up to close shore so fishermen capitalize on this and catch them all along. This was according to one of the elders interviewed who said when young he could see his father predicting there will be a good catch of ngenge (Luo word for tilapia) whenever lake-flies emerged. These findings are in agreement with Allison *et al.* (1996) who also noted that lake flies are fed on fish and terrestrial animals when they emerge. There is belief that with the beginning emergence of lake flies there will be a good crop harvest because it is used as a traditional indicator for the rainy season has arrived and that people begin to prepare their land for cultivation. Stated similar responses of the participants (letter B).

DISCUSSION

The main objective of this paper was to identify sustainable traditional collection practices of lake flies for increased availability, there is sustainability because they are used as food, beliefs attached and the raw materials of papyrus lid for construction of these

traditional devices are locally available along the lake. The study was a success in that it is possible to have an adequate collection of lake-flies by utilizing the natural phenomena of rain fall, lunar periodicity and presence of strong winds to forecast the emergence and using traditional tools of odheru, olungro, pots and basins to catch the lake-flies when they land on vegetation along the shore, mid-air flight and as they are attracted to light source correlating findings were found by Rentokil (2021) and van Huis (2003). The study recommends the use of olungro, basins and pots to collect lake flies when in mid-air flight because they are convenient to operate in such activities and their large volume space enables them to have an adequate catch. They collect the lake flies with little impurities since it is just the insects in flight. Use of odheru, basins and pots to collect lake flies from bushes and vegetation because the tools have large volume space and do not have handles so they are easy to operate for these activities ensuring that there is an adequate catch. The disadvantage there are impurities in leaves and other organisms. Use of solar touches at night to collect lake-flies during their season to maximise catch. Upgrade the collection olungro into a flexible net-mesh with a plastic handle so to make the activity convenient. There is the potential of commercialising lake flies by incorporating modern technologies in the collection to increase catch and using them as food and feed similar to findings in a commercial by Ayieko *et al.* (2010). They can be used to fortify other products which have inadequate protein content to enhance their protein content. Extract their medicinal values of remedy for sickness and enhance sexual desire for a generation of trade products for human use. Lake flies are associated with myths which assist in motivating in collection and preservation of the value of the insect to the community. There is a need for further documentation on the underworld value of lake flies. These forecasting and collection techniques can be applied anywhere in the freshwater regions where lake flies emerge and will produce effective and efficient results. There is a need for policy-makers to consider the creation of policies which enlighten the value of insects on nutrition to the community and train livestock departments in ministry of agriculture to impact the current generation on farming and sustainable collection of insects in the environment so that food insecurity is mitigated. Preservation of collection knowledge can be retained by involving both genders in the collection and

processing activities so that generations coming and going the knowledge is sustained. This traditional knowledge is vital in ensuring food security by enabling the community to forecast the emergence and use locally available materials to construct collection tools of the insect's findings correlate with Corbet (1964) and Ayieko and Oriaro (2008) studies. The medicinal usage of lake-flies to improve libido can be added value by formulation of drugs to assist people who have challenges in dysfunction obtaining sexual desire this is similar to findings by Nowakowski *et al.* (2022). Further study to identify the chemical compounds in the insect responsible for curing stomach aches and skin diseases that there is the creation of the drugs which are a remedy to these diseases.

CONCLUSION AND RECOMMENDATIONS

In summary, the study results indicate that Lake flies' collection has the potential to contribute to food and nutrition security because it is an alternative protein and micronutrient source in fresh water regions. Sustainability of collection practices can improve with enhancement with modern technology to increase the catch of lake-flies and this can aid in poverty reduction in that with adequate catch together with value addition to improve taste, appearance, smell and texture to promote consumer acceptability which led to more cash demand on the insect. When more people are aware of the value of lake flies, traditional knowledge will be appreciated and documented and improved with further scientific research details on the collection and uses.

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Appendix

Table 1. Emergence and collection of lake flies theme.

Sub-themes	Participant number or letter	Quotation	Summary remarks
Lunar periodicity	1	"They appear as a large cloud like smoke in the air from a distance when they come out of the lake."	The study noted that for lake-flies to emerge there is occurrence of three traditional indicators: rain, full moon season and presence of strong winds. It was women responsibility to collect the lake-flies with traditional instruments constructed with papyrus lids found along the lake shores and kitchen utensils which had large volume in them i.e. pots.
	2	"I have ever eaten Sam which my grandmother used to prepare when I was young."	
	A	Sam appears when the moon is half risen during the moon period on the lake horizon that is when Sam starts to appear."	
	B	"We know Sam is coming when you look at the lake and see a large brown cloud coming, that is how we know."	
Presence of strong winds	C	"Sam come with winds very strong winds" then the participant went further "these winds have names depending on their strength and direction which they come from, the most powerful wind is Ogingo. When it comes even the trees shake seriously with power of the wind." went on "another powerful wind but lesser than Ogingo is Yandha this one brings Sam from that direction to Mfangano this wind does not shake trees like Ogingo, another wind called Komathi blows away Sam from Mfangano and Genya is not power like Komathi it just	

		blows and it does not have Sam in it.”
	D	“When rains are there coming and wind was bringing them along the lake some overlapped to forest over the lake. They mostly came from the side of Uganda and Mfangano, mostly during the rainy season and they were also a sign of rain and fish cause at that time we would also get a lot of fish because they were coming running along the lake and you know even, I think even fish was also eating them.”
Rain season	E	“We could see them, they come in a group like swam, have you seen some of the birds that sometimes come in a very big group so it would come and then rains come they would come like a cloud coming from Uganda side.”
Collection from the bushes and vegetation	E	“Sam in those days was collected by women only and were allocated specific places as there collecting station kitimbo, they used odheru/otete to collect Sam from the bushes which they found” when asked why women only the participant responded that “we men our job was to go and fish, so that we provide for the house.”
	A	“Women were the ones responsible for collecting and preparing the Sam for the house, they collected Sam using raungi to collect.”
Mid-air flight collection	C	“Sam was collected when they were flying through the land in large smoke by whirling odheru in the way they were flying.”
	E	“When Sam could be collected in air using a traditional basket called olungro” when probed what is olungro “an olungro is woven basket made from papyrus lids which are found along the Lake Victoria shores, the basket is rigid and not flexible with a stick attachment.”

Table 2. Myths and uses associated with lake-flies theme.

Sub-themes	Participant number/letter	Quotation	Summary remarks
Marriage partner or business attraction	1	“I heard my grandmother saying Sam has many uses as food and for medicinal purposes” when she was probed, she continued “my grandmother did not explain the details”	Lake-flies are associated with many myths starting from where they originate and their use. The study investigation has indicated that their exact point of origin is not clear from the lake and that they are utilized traditionally to enhance manpower, attract customers business or love partner, increase
	2	“There is a certain herbalist/ witch doctor who says when you want to have more catch of fish you need to go to him with lake-flies as part of the ingredients of the charm.”	
	3	“My friend went to herbalist/ witch doctor looking for love charm and was instructed to bring some Sam for the ritual.” “The friend did not know whether they add or they just use it like that.”	

Superstition on source of lake-flies	4	“The place where Sam comes from is far and far away deep in the lake, it comes from Migingo island. On this Island there are no people habitation, the waters around this Island very thick and you cannot see through them. When at this place you hear strange voices not knowing where they come from.”	fertility in people and to increase fish catch.
	5	“When we were young, we used to hear stories that Sam comes whenever a mysterious old woman puffed.” “I do not know where she is but all we were told is that the woman is from the lake.”	
Libido	A	“Men of those days because of eating Sam we were able to have several wives and we were able to satisfy them and bare children and had increased strength.”	
Remedy for sickness and diseases	B	“During our time we ate Sam, to treat stomach pains whenever someone suffered.” “Even when the skin started rash or any abnormality, we used to eat Sam to treat the sickness and it worked very well.”	
Good fish harvest	C	“They were bringing a sign of we will have a good harvest because they generally come with rain and that there will be a good catch of fish because fish also eat them.”	
	A	“One of my friends said there is a herbalist who makes charm to catch more fish by using lake flies”	
	D	“I have been in the lake for years we used to fish this ngege so I could see my father when he sees from the far distance would start appreciating that today will be a good catch and automatically when you go and cast net where they are you would get a good fish .”	

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