

Turning Notorious Mosquito Larval Habitats Into Sources of Wealth and Social Equity



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Context

→ Pervasive cultural barriers restrict female participation in a vibrant artisanal capture fishing industry that forms the primary income source in Kenya's Lake Victoria fishery.

→ Traditionally, men work as fishing crew

→ They capture fish from the open lake



Context

- Women work as fishmongers.
- They receive fish from fishers and then sell it in markets



Context

→ As fishing boats return ashore the crew and the women negotiate about the catch

→ Depending on the negotiations, the **women will then trade sex for the assurance of the best of the catch, a discounted price or no price**



Context

- This marginalizing culture:
 - a. affects women's mental and behavioral health
 - b. denies women their human and sexual rights, and
 - c. is a major route to acquisition and spread of venereal diseases
- ...and explains the high HIV burden in fishing communities, which also exhibit stable malaria transmission
- Empowering women with means of production within the local artisanal fishing industry can dispel these deplorable gender, health and socioeconomic dynamics

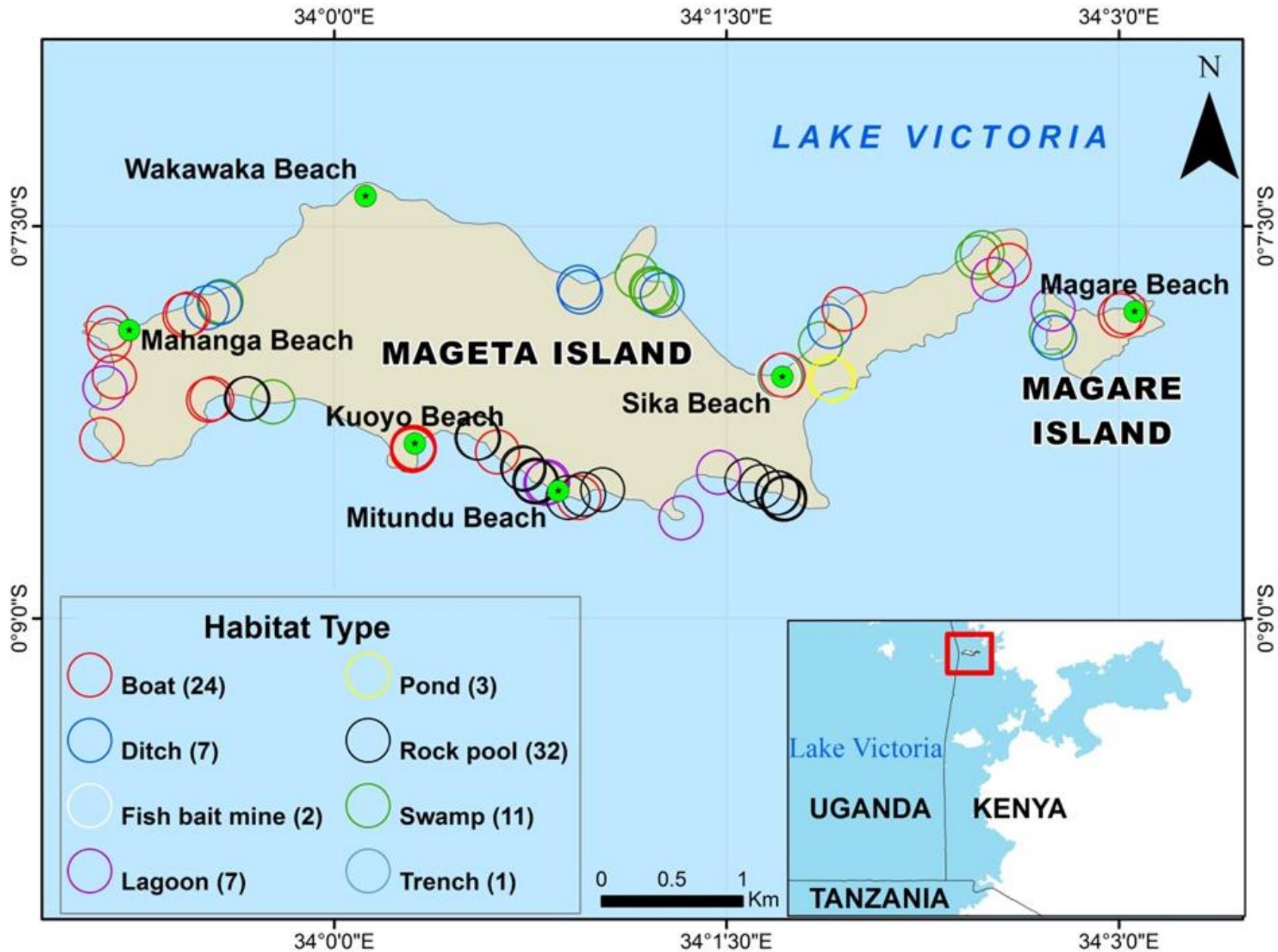
Research questions

- a. Does artisanal capture fishing significantly contribute to mosquito breeding?
- a. Can raising fish in notorious breeding habitats eliminate malaria mosquitoes?
- b. Can practical ecological skills applicable to mosquito control foster social justice and independence among marginalized women

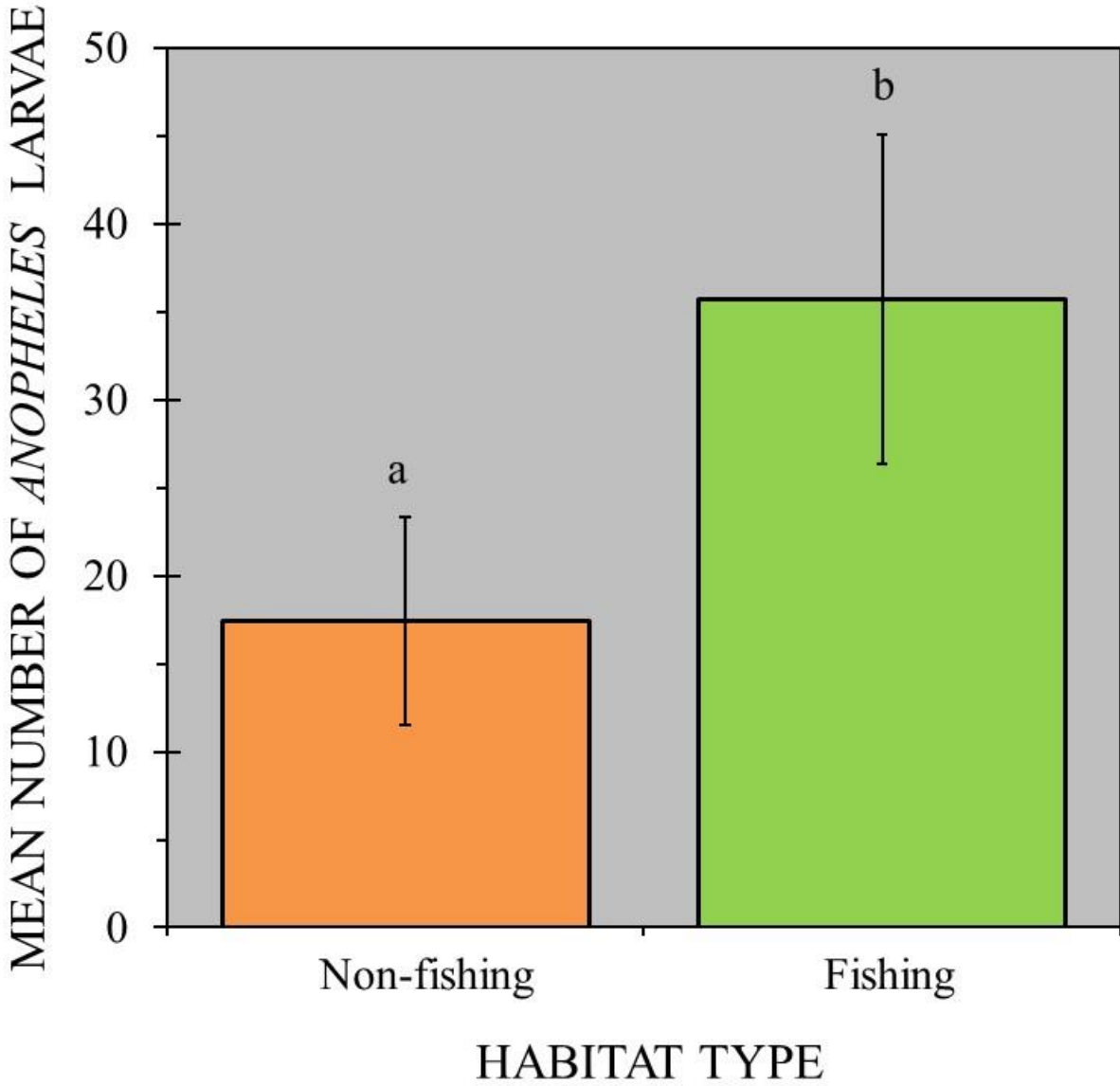
1. Does artisanal fishing significantly contribute to mosquito breeding?

- We used an ecosystem approach to understand the association between artisanal fishing and the problem of malaria on Mageta Island in western Kenya
- This was achieved through a cross-sectional survey seeking:
 - a. to determine if artisanal capture fishing leads to creation, hence occurrence, of *Anopheles* breeding habitats, and
 - b. to establish the potential correlation between artisanal capture fishing and *Anopheles* larval productivity

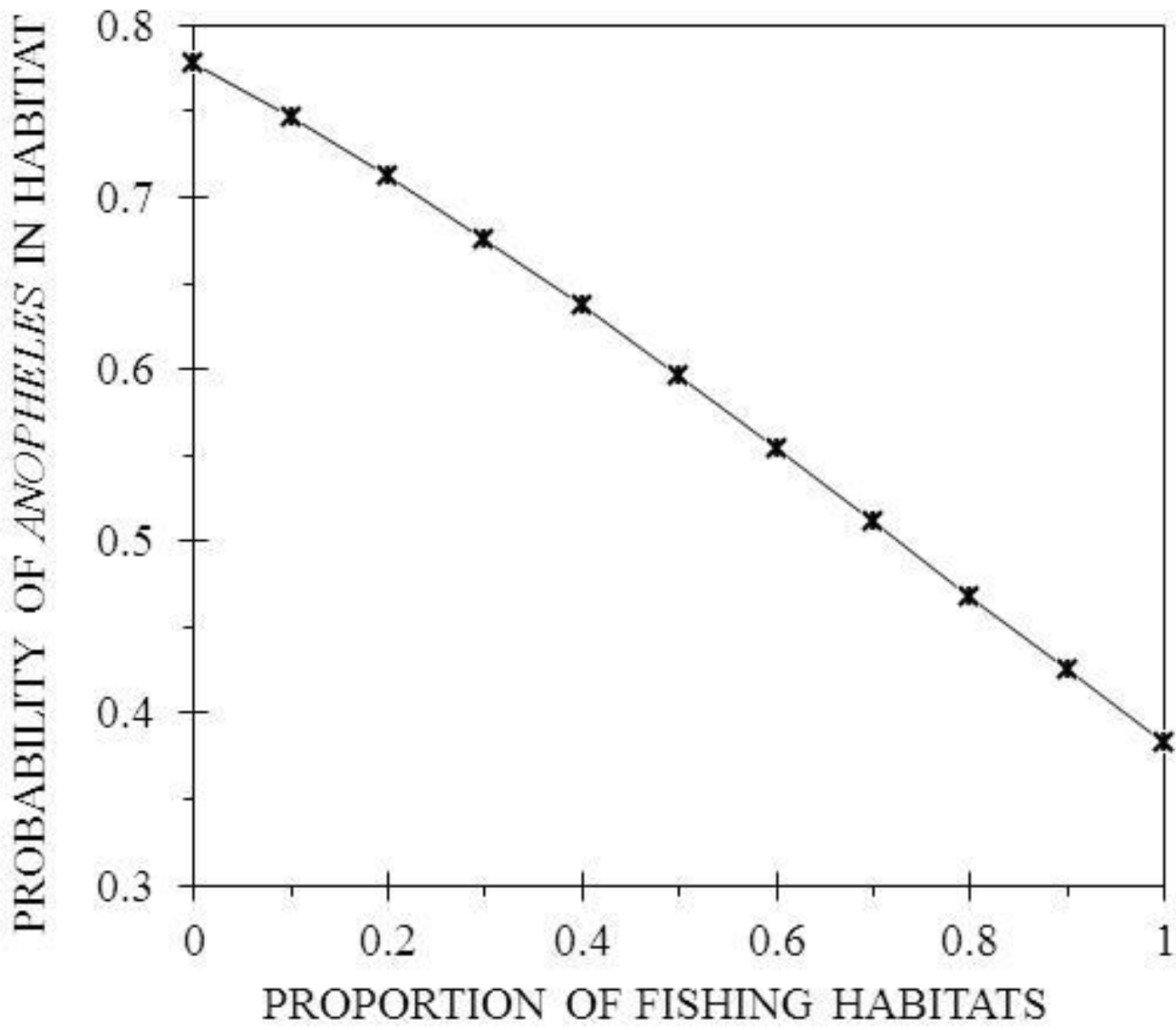
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RESEARCH

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Artisanal fishing supports breeding of malaria mosquitoes in Western Kenya

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Abstract

Background: Everyday hundreds of people, mainly men, set out to take part in a vibrant artisanal capture fishing (ACF) industry on Lake Victoria. It is not known whether actions of artisanal fishers, in their unrelenting quest for existence, surpass ecosystems' sustainability thresholds with potentially negative repercussions on human health with respect to malaria transmission potential. This article sought to fill this information gap.

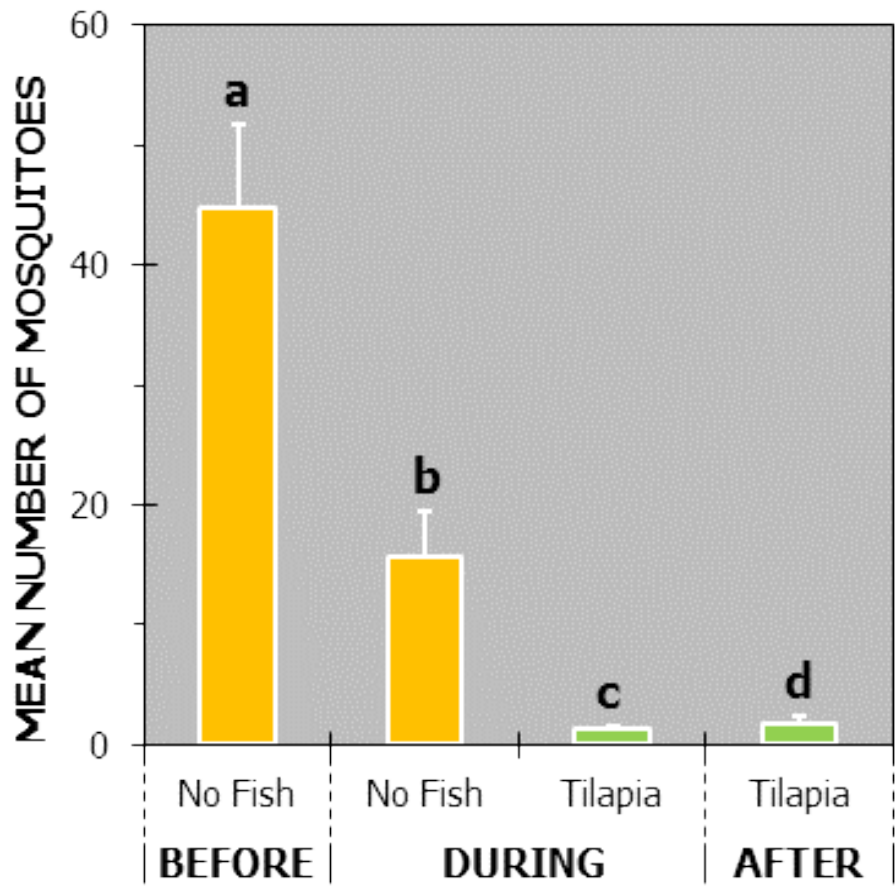
Methods: This study used an ecosystem approach to find out how ACF processes facilitate the breeding of mosquitoes. The observational study adopted a cross-sectional design and was carried out on Mageta Island situated inside Lake Victoria in western Kenya.

Results: Of the 87 mosquito larval habitats identified 27 (31%) were created through ACF activities. The ACF-related habitats, hereafter collectively referred to as 'fishing habitats', included fishing boats (24), trenches (1) and fish bait mines (2). About half (48%) of *Anopheles* larvae were recovered from fishing habitats. The mean larval density in the fishing habitats (35.7 ± 1.15) was double that in non-fishing habitats (17.4 ± 0.539). Despite being the most common 'non-fishing habitat' type ($N = 32$), the mean number of *Anopheles* larvae present in rock pools (30.81 ± 10.54) was significantly less than those found inside fishing boats ($N = 24$; 40.08 ± 10.16). Overall, man-made habitats and those used to support livelihoods contained significantly more *Anopheles* larvae.

Conclusions: These data show that artisanal capture fishing is a key driver of malaria epidemiology on Mageta Island. This suggests that larval source management strategies in the global south should pay attention to the heterogeneity in *Anopheles* breeding habitats created through livelihood activities.

Keywords: Artisanal capture fishing, Mosquito larvae, *Anopheles gambiae*, Larval productivity, Habitat, Fishing boats, Malaria, Mageta Island, Kenya, Lake Victoria, Ecosystem health, Ecohealth

2. Can raising fish in notorious breeding habitats eliminate malaria mosquitoes?



Mean numbers of *Anopheles gambiae* mosquito larvae collected from habitats in Musoma village, Mgeta Island, before, during and after introducing fingerlings of the edible fish *Oreochromis niloticus* (tilapia). Bars with different letters denote significant differences in numbers of larvae collected in that treatment.

3. Can practical ecological skills applicable to mosquito control foster social justice and independence among marginalized women

- performed key informant interviews (KIIs) & focus group discussions (FGDs)
- Aim: identify 'female-friendly' activities of the local artisanal fishing industry that mutually enhance HIV/malaria control & generate income for local women
- Three activities were identified:
 - a. Turn permanent mosquito habitats into commercial culture units for edible fish
 - b. Turn notorious mosquito larval habitats into shopping baskets for malaria control
 - ~~c. Develop fishing boats project for female community health social entrepreneurs~~
 - d. Develop a social enterprise promoting community health and social justice

a. Turning permanent mosquito habitats into commercial culture units for edible fish

- It was noted that **enlarging and deepening permanent habitats (e.g. lagoons and ditches) of malaria mosquitoes makes them (the habitats) suitable for culturing tilapia** (edible fish), which will subsequently control malaria mosquitoes
- This project is suitable for women because:
 - a. It cannot prevent women from doing other household chores
 - b. exclusion of men helps women guard their earnings (from men)
- **Tilapia is a local delicacy**, is very tasty, has a good local market value, has high demand and is the most common fish offered in local hotels and restaurants
- Thus, **tilapia aquaculture offers high potential for income generation for women entrepreneurs**
- We calculated that 12 fish ponds stocked to capacity (4,500 fish per pond) will **yield a gross total of USD 162,000 per annum**

b. Turning notorious mosquito larval habitats into shopping baskets for malaria control

- fishing boats are the main habitat type of malaria mosquitoes on Mageta Island
- Most of the boats are used in fishing activities targeting the Nile perch (*Lates Nilotica*)
- As routine practice water is poured inside boats parked ashore (between fishing sessions) in order to prevent the wood to crack as a result of intense insolation
- KII's and FGDs revealed that Nile perch fishing depends on using fishing baits
- ...and that the fishing baits are collected/gathered by women
- Gathered fish baits are normally put inside the boats (fishing baskets)
- We decided to identify fishing baits used for catching Nile perch
- Aim is to find types that are mutually useful for mosquito control and income generation for local, marginalized women

b. Turning notorious mosquito larval habitats into shopping baskets for malaria control

Identity of Nile perch fishing baits		Perceived catch efficiency rankings										
Scientific name (local name)	Common name	P1	P2	P3	P4	P5	P6	P7	P8	P9	Mean	Over
<i>Mormyrus kannume</i> (Suma)	Bottle nose fish	3	6	2	1	1	1	1	1	1	1.89	1
<i>Schilbe intermedius</i> (Sire)	Silver catfish	1	1	1	2	4	5	2	2	2	2.22	2
<i>Clarias alluaudi</i> (Ndira)	Alluaud's catfish	4	4	3	4	3	2	3	4	4	3.44	3
<i>Synodontis victoriae</i> (Okoko)	Lake Victoria squeaker	2	5	2	3	5	6	4	3	3	3.67	4
<i>Haplochromis nubilus</i> (Fullu)	Blue Victoria mouth breeder	5	3	4	5	2	3	5	5	5	4.11	5
<i>Rastrineobola argentae</i> (Omena)	Lake Victoria sardine	6	2	5	6	6	4	6	6	6	5.22	6



b. Turning notorious mosquito larval habitats into shopping baskets for malaria control

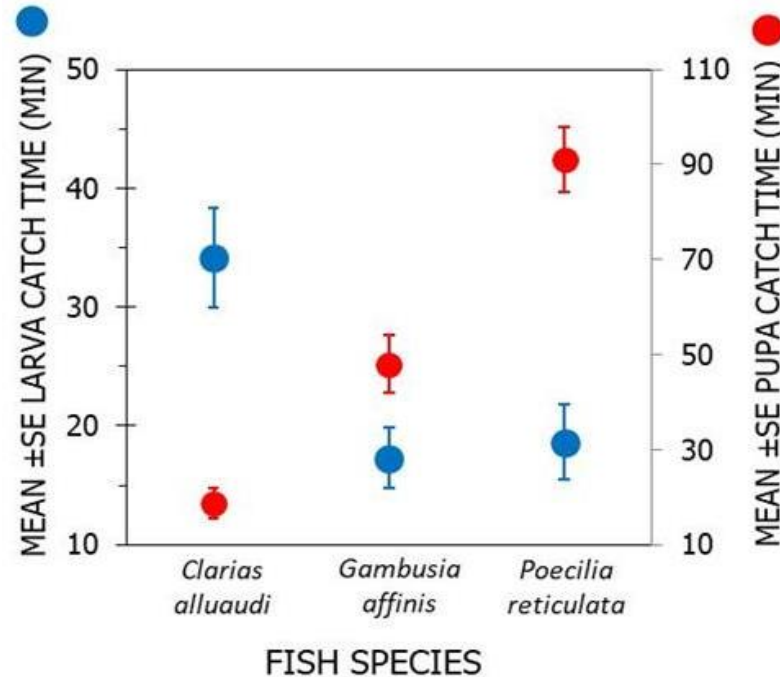
→ The '*Ndira*' project is particularly suitable for women because:

- (a) culturing this fish species is not laborious and does not need to be fed at all
- (b) local price of '*Ndira*' is independent of its size
- (c) '*Ndira*' is highly reproductive
- (d) '*Ndira*' has a short lifespan
- (e) rearing '*Ndira*' needs a small area
- (f) '*Ndira*', and other local fish baits, are customarily gathered by women
- (g) '*Ndira*' is sold in cash, therefore no debts are incurred
- (h) '*Ndira*' is customarily placed directly in water inside fishers boats after purchase
- (i) unsold '*Ndira*' are returned in ponds because they stay alive for long outside water

b. Turning notorious mosquito larval habitats into shopping baskets for malaria control

We calculated that selling 600 individuals of 'Ndira' to each one of 20 fishing boats per day will yield a gross total of USD 216,000 per annum

b. Turning notorious mosquito larval habitats into shopping baskets for malaria control



Mean (\pm SE) amount of time (minutes) taken by individuals of three fish species (*Clarias alluaudi*, *Gambusia affinis* and *Poecilia reticulata*) to consume larvae and pupae of *Anopheles gambiae* mosquitoes.

→ *Clarias alluaudi* consumed a significantly higher number of late instar larvae of *An. gambiae* (676.33 ± 72.05) as compared to *G. affinis* (117.33 ± 14.65) and *P. reticulata* (54.0 ± 10.62)

c. Develop a social enterprise promoting community health & social justice

- We propose to select, develop and test a business approach that will create wealth, foster gender equality and promote community health on Mageta Island
- Our idea is to manipulate notorious mosquito breeding habitats by making them suitable for the commercial production of edible fish (tilapia) and bait fish (Alluaud's catfish) - *enterprise orientation*
- Intensive fish farming will help to control malaria mosquitoes and avert HIV transmission - *social aim*
- Intensive fish farming will also guarantee local availability of fish protein and help to avert malnutrition - *social aim*)

