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NU-KMFRI JOINT SEMINAR

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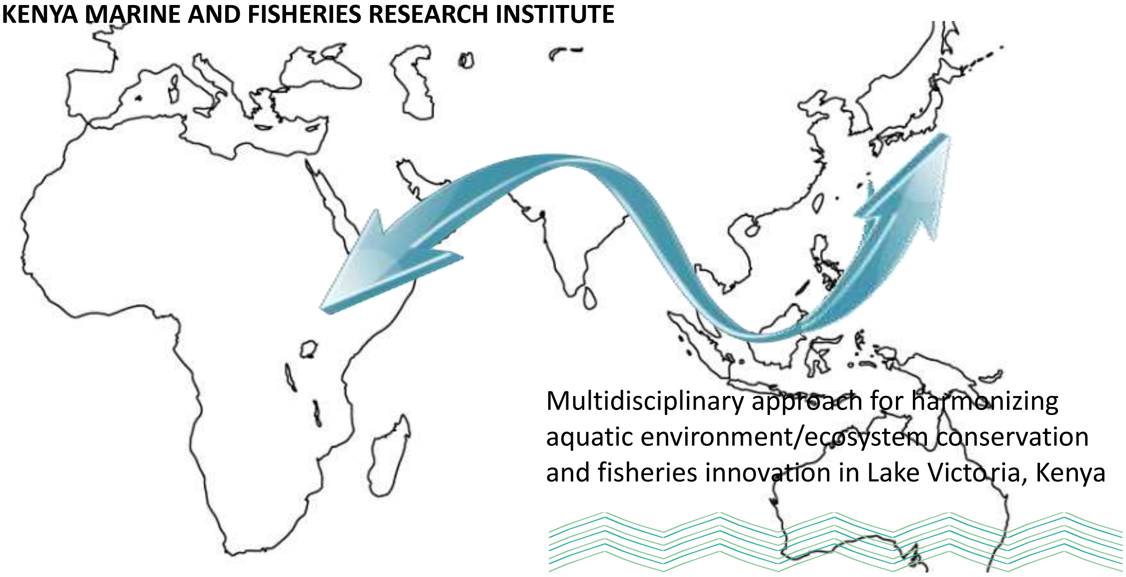

BOOK OF ABSTRACTS

Book of Abstracts JSPS CORE-TO-CORE PROGRAM - ASIA-AFRICA SCIENCE PLATFORMS NU-KMFRI JOINT SEMINAR

Editors:
Yoshiki Matsushita, Helen Marcial, Enock Wakwabi and Kenneth Werimo

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There were 21 presentations within the theme aquatic environments, fisheries, aquaculture and post-harvesting technologies.
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Research Priorities in Freshwater Fisheries and Aquatic Sciences in Kenya

William Oweke Ojwang

Kenya Marine & Fisheries Research Institute, Kisumu Research Centre, P. O. Box 1881-40100, Kisumu, Kenya

Kenya is endowed with remarkable freshwater resources inhabiting several contrasting and diverse freshwater aquascapes ranging from the largest freshwater water lake in the tropics: Lake Victoria; the Rift Valley Lakes: Turkana, Naivasha, Baringo, Bogoria, Nakuru, and Elementaita, all of the rift lakes and associated wetlands are designated as Ramsar sites, except for Lake Turkana, which is the largest desert lake in the world and is designated as a World Heritage site by UNESCO. Other freshwater aquascapes includes: rivers, dams and wetlands. The most important freshwater resource in Kenya is the fisheries. The fisheries sector, which includes other aquatic resources, continues to play an important role in the social and economic development of the country. Over 2.3 million Kenyans depend on the sector directly or indirectly as a source of livelihoods, employment and other economic sustenance. The overall contribution of fisheries to GDP is reported, as about 0.5%, however this does not adequately consider the value of all inputs in fisheries production and value addition, which could be as high as 5%. Additionally, it earns about Ksh. 8 billion to fishers along the landing sites, Ksh. 11 billion gross earnings to traders along the domestic market value chain and gross value of Ksh. 7.5 billion at the wholesale export market level.

To harness the potential of fisheries and other aquatic resources in the economic growth of the nation, it is imperative that; emerging fisheries and environmental challenges such as those associated with global climate change are addressed through innovative scientific approaches; data and information on both biotic and abiotic components of the ecosystem are continuously acquired and updated respectively, and important biological reference points to guide management determined; potential of aquaculture including cage farming assessed and systems developed to supplement declining capture fisheries. These takes cognizance of the dynamism of the ecosystems, which are mostly human induced and therefore continual need to inform new policies and provide legal frameworks to support mitigation strategies, expounded in the Kenya Vision 2030 and other national development strategies. This paper discusses challenges and threats facing major freshwater ecosystems in Kenya and highlights specific research priorities in respective major lakes and associated systems. Key words: Lakes, fisheries, research, policies, resource potentials

Status of cooperation between NU and KMFRI

Yoshiki Matsushita[1], Atsushi Hagiwara[1], Enock Wakwabi[2], and William Ojwang[3]

[1]Graduate School of Fisheries Science and Environmental Studies, Nagasaki University, Nagasaki, Japan

[2]Fisheries Scientist / Consultant, Deputy Director, KMFRI Inland Waters Research Division

[3]Kenya Marine & Fisheries Research Institute, Kisumu Research Centre, P. O. Box 881-40100, Kisumu, Kenya

Academic cooperation between Nagasaki University (NU) and Kenya Marine and Fisheries Research Institute (KMFRI) was started since some professors visited KMFRI in January 2011. In summer of 2011, representatives of KMFRI visited Nagasaki and they signed a memorandum of understanding (MOU) on the academic cooperation. In 2012, the 1st joint seminar was held at Kisumu supported by Japan Society for the Promotion of Science (JSPS) bilateral program.

Active cooperation was accelerated after 2013 when 3-year JSPS Core-to-Core Program (Asia-Africa Science Platforms) was adopted. Through this project, NU has provided opportunities of short term training in NU for 4 young KMFRI scientists so far. In this year, NU also could successfully invite a KMFRI researcher for JSPS RONPAKU Dissertation PhD Program. In addition to those many supports, the new project called LAVICORD (Lake Victoria Comprehensive Ecosystem and Aquatic Environment Research for Development) was launched in February 2014. This is a project between NU and Maseno University, but KMFRI takes a main role for Fisheries Component. In the same year, the International Priority Graduate Program was adopted in NU and started to accept young scientists from Kenya.

Thus, both organizations are expanding ranges of cooperation for research and capacity buildings.

Candidate aquatic weeds for surveillance and monitoring in Lake Victoria Basin, with special reference to Water Hyacinth, *Eichhornia crassipes*

Reuben Omondi

Kenya Marine & Fisheries Research Institute, Kisumu Research Centre, P. O. Box 1881-40100, Kisumu, Kenya

Among the macrophytes found in Lake Victoria basin, a number have detrimental impacts both in the lake and other aquatic ecosystems. Surveillance and monitoring of aquatic weeds can lead to containment and/or eradication at an early stage of invasion. Surveys were carried out in Lake Victoria and other adjacent water bodies to determine the status of aquatic plants. The paper presents spatio-temporal distribution of water hyacinth in Nyanza gulf using remote sensing technique. The distribution of significant aquatic weeds in Lake Victoria basin is described. The ecological impact of the plants and possible transmission routes are also mentioned. Apart from the threat posed by alien invasive species, water hyacinth and *Egeria* sp, there are also rampant transmission of native weedy aquatic plants from one water body to another in the basin. Report is made on the threats by further invasion, by new alien invasive macrophyte species, of aquatic ecosystems in the basin. The paper recommends on the use of local communities for surveillance and monitoring of aquatic weeds in the region with aim of assisting in their management and control.

The survey of nutrient conditions at coral reefs based on stable isotopes techniques

Yu Umezawa

Faculty of Fisheries, Nagasaki University, Nagasaki, Japan

At the coastal areas in Kenya, there are developed fringing coral reefs with different ecological characteristics. For example, the coverage of coral species are different among the locations, and the occurrence of coral bleaching and their recovery were different among the reefs (pers. comm. Jelvas Mwaura). We expect that temporal changes and spatial difference of these ecological characteristics can be affected by multiple stresses in the environment, including nutrient dynamics along the Mombasa coast.

Although some of the data on nutrient concentrations in water column along Mombasa coast are available, the measured values are just snapshot data, and do not necessarily represent time-averaged conditions. On the other hand, nitrogen stable isotope ($\delta^{15}N$) and nitrogen contents (N %) in macroalgal tissues, which grow at the exact locations in several weeks and months, are useful tool to monitor time-averaged (integrated) nutrient conditions in the water column. Generally, $\delta^{15}N$ in wastewater from residence area is significantly heavier than that in other nitrogen sources. When $\delta^{15}N$ of each potential N source is significantly different, $\delta^{15}N$ in algal tissue suggest relative contribution of each N source to macroalgae. Therefore the information on $\delta^{15}N$ in macroalgae help us to trace the actual use of terrestrial nitrogen by primary producers as time-integrated data during their growing period.

In case that a same species of macroalgae is not available due to the lack of the hard substrate, sedimentary organic matter (SOM) have potential to show similar characteristics ($\delta^{15}N$ gradient from the shore to the reef crest) to macroalgae due to the contribution of high amounts of benthic microalgae. Macroalgae generally record the nutrient regime during a couple of weeks, while SOM includes a certain amount of organic matter which have accumulated for longer period. Therefore $\delta^{15}N$ of macroalgae and SOM can be used in a complementary manner, over various time scales, as indicator of the integrated effect of DIN sources

If wild macroalgae and natural SOM are not uniformly available at the target area, we can manually put cages with fresh fast-growing macroalgae (e.g., green algae, *Ulva* spp.) and compare the shift of algal $\delta^{15}N$ values and N(%) from the original ones at each location. This technique is applicable to everywhere in the shallow water system. As indicator of the time-integrated information on DIN sources, $\delta^{15}N$ and N(%) of wild or manually incubated macroalgae and SOM can be used in a complementary manner, over various time scales, according to the purpose.

Recent Trends in Limnological and Environmental Health Conditions of Lake Victoria

Collins O. Ongore

Kenya Marine and Fisheries Research Institute, P.O. Box 1881- 40100, Kisumu, Kenya.

Lake Victoria, the world's second largest freshwater body has undergone gradual changes within the last century, which are driven by catchment based human anthropogenic impacts on one hand and global climate change effects on the other. In recent times, scientific investigations have revealed a trend of dramatic spatial and temporal variations in limnological as well as environmental health conditions which have had serious ramifications on the ecological wellbeing of the lake. Temperatures in Lake Victoria have showed a general increasing trend with fluctuations around 25 ºC of mean column temperature of over the last decade and an increase of 0.2 ºC within the last 4 years alone. There have also been associated fluctuations in dissolved oxygen levels within the water column sometimes resulting into mid and bottom water anoxia. Increased water turbidity caused by elevated sediment load inflow and eutrophication conditions derived algal proliferation has exacerbated the water column warming effect and dissolved oxygen depletion. Elevated nutrient concentration in the water column is also one of the precursors of the problem of proliferation of water hyacinth and other aquatic weeds. Presence of contaminant toxic metals residues and organic pollutants has also been detected in various matrices from the lake, with variations between different zones of the lake, thus causing worries of potential bioaccumulation and biomagnifications in the aquatic food chain. Most of the pollution impacts are concentrated around shallow littoral areas especially the sheltered bays and the major gulfs of the lake. The pattern of general decline in stocks and near disappearance of some of key commercial and native fish species is not only associated with human overexploitation of these stocks but also and majorly with these pollution derived changes. In this review some of the findings of recent scientific investigations in Lake Victoria have been highlighted by establishing the trends in environmental stress indicators while suggesting possible ways to mitigate the impacts in tandem with the current intervention measures, and restore the environmental health of the Lake.

Linkage between changes in monsoon climate and fishing ground environment off Kenya

Shigenobu Takeda[1], Yoshimi Takao[2], Daisuke Tsumune[3], Kazuhiro Sadayasu[2], Yoshiki Matsushita[1], Kazuhiro Misumi[3] and Takaki Tsubono[3]

[1] Faculty of Fisheries, Nagasaki University

[2]Fisheries Research Agency, Japan

[3] Central Research Institute of Electric Power Industry, Japan

The seasonal reversals of wind by monsoon climate play a significant role in the variability in the circulation, themohaline structure, and the chemical and biological distributions in the Indian Ocean. Its spatio-temporal variability could have strong influence on supplies of nutrients through strong coastal upwelling, vertical mixing or lateral advection of coastal waters and consequently phytoplankton productivity that supports marine food web including fisheries resources. In order to understand linkage between changes in monsoon climate and oceanographic environment of fishing ground off Kenya, we are proposing a new cooperative research project of Kenya and Japan. This project includes 1) monitoring of fishing ground environments and fishery resources off Kenya using Seaglider together with oceanographic field observation of Kenyan coastal waters by research vessel, satellite remote sensing of sea surface chlorophyll *a* and current/circulation off Kenya, and 3) impact assessment of monsoon climate change on the fishing ground off Kenya using Global-scale Marine Ecosystem Model. Seaglider is an autonomous underwater vehicle that utilizes wings and small changes in buoyancy and attitude to achieve forward motion and navigation (body Length 2 m; body diameter 30 cm; weight 52 kg). Collected data is transmitted in near real time to the base station after the completion of each dive, and vehicle is piloted remotely via the internet and Iridium satellite communications. Fisheries echo sounder (Imagenex ES853, 120 kHz single-beam) can be integrated into the vehicle, and it enables us to monitor biomass in the layers of 70 - 1000 m depth in the western Indian Ocean up to 10 months along a 4,600 km transect (Equivalent to 650 dives to 1,000 m). The Biogeochemical Elemental Cycling (BEC) model, which simulates ocean biogeochemistry and lower-trophic-level marine ecosystem dynamics, and the high resolution (0.1º x 0.1º grids) Parallel Ocean Program (POP) are useful tools for better understanding of mechanisms that modulate biological productivity in the waters off Kenya, and its sensitivity to a changing global climate. Based on the data set of environmental factors and fisheries resources provided by this project, we would establish a scheme for effective utilization of fishery resources off Kenya.

Preliminary observations of artisanal fisheries of Lake Victoria in two selected landing sites in Kenya

Monica Owili

Kenya Marine and Fisheries Research Institute, P.O. Box 1881- 40100, Kisumu, Kenya.

This study presents preliminary observations in the artisanal fishing at two landing sites (Honge and Wichlum) in Lake Victoria, Kenya. Fishing effort (CPUE) and a number of morphometric characteristics of two fish species of commercial importance in Lake Victoria were monitored over a period of five months (June-October 2014). The monitoring was done by involving the Beach Management Unit (BMU) members at these landing sites and LAVICORD research team in a daily and weekly data collection process respectively. CPUE for *R.argentea* were relatively higher at Honge compared to Wichlum and similarly higher in Sesse motorized boats (253.9 ±15.5 – 558.5 ± 112.3 kg boat^{-1} day^{-1}) compared to those propelled by paddles (65.7 ± 8.6 -117 ± 14.8 kg boat^{-1} day^{-1}). Relatively higher CPUE was realized for Nile perch, *Lates niloticus*, from boats using longlines (6.0 ± 3.7-23.9 ± 6.2 kg boat^{-1} day^{-1}) compared with those operating gillnets gears (2.8 ± 0.54 - 9.67± 1.4 kg boat^{-1} day^{1}). The distribution of the population of the species (*L.niloticus*) was bimodal, with the total length ranging from 9 to 129 cm with corresponding weights of 11.0 to 28,500 g respectively. Continued monthly sampling is therefore necessary in order to acquire substantive data to authenticate important fishing grounds for these species as a precursor to the introduction of enhanced fishing technology and formulation of policies to safeguard the habitats and the fisheries resources for the future generations.

Monitoring fishing efforts for Omena *Rastrineobola argentea*

Yoshiki Matsushita[1], Xiaofeng Ou [1], Keiko Kito [1,3], William Ojwang [2], Monica Owili [2] and Edwine Yongo[3]

[1] Graduate School of Fisheries Science and Environmental Studies, Nagasaki University, Nagasaki, Japan

[2] Kenya Marine & Fisheries Research Institute, Kisumu Research Centre, P. O. Box 1881-40100, Kisumu, Kenya

[3] LAVICORD

We have been monitoring behaviour of 4 fishermen in Honge and Wichlum Beach Management Units (BMUs) since June 2014 to understand spacio-temporal distribution of fishing efforts of Omena fishery, because effort control is desired for the fishery management. A GPS data logger and a logbook was distributed to each fishermen and they were requested to take the GPS logger with them when fish and to record time of fishing and catch amount. Every week we visited BMUs and retrieved data from GPS loggers and logbooks. Records in logbooks were input in the Excel file and converted into CPUE (kg/boat/day). GPS data was analysed by using Open Source Geographic Information System, QGIS and CPUEs overlapped over the map of Lake Victoria each month. Fishing boats tended to expand their fishing area from near coast to offshore during June to September. We found the median of CPUE varied from a few kg to a few hundreds kg by differences in BMUs and type of boat (motor or paddled), although they are categorized in one fishery sector. Classification of fishing sector (i.e. size of boat and gear, use of engine etc.) may be necessary for better management.

Ecological Modelling of Lake Victoria using Atlantis Framework

Chrispine Nyamweya

Kenya Marine and Fisheries Research Institute, Kisumu Station, P.O. Box 1881-40100, Kisumu

University of Iceland, School of Engineering and Natural Sciences, Department of Statistics

In Lake Victoria, arguments and counterarguments of the system dynamics, major processes, drivers and responses have formed the bulk of existing scientific literature. However little headway has been made in any in identifying the major drivers of ecosystem changes that have been witnessed in the last 6 decades. Most of the work done the lake often focus on one or a few aspects of the system and often fall short of giving the big picture. Atlantis Ecosystem model provides an opportunity of building a virtual ecosystem with which different management regimes can be road tested before actual implementation. It considers all aspects (parts) of an ecosystem - biophysical, economic and social. At the core of Atlantis is a deterministic biophysical sub-model, coarsely spatially-resolved in three dimensions, which tracks nutrient (usually N and S) flows through the main biological groups in the system. The primary ecological processes modelled are consumption, production, waste production, migration, predation, recruitment, habitat dependency, and mortality. The physical environment is also represented explicitly, via a set of polygons matched to the major geographical and bioregional features of the simulated lake system. The model also includes a detailed industry (or exploitation) sub-model that is focused on the dynamics of fishing fleets. The exploitation model interacts with the biotic part of the ecosystem, but also supplies 'simulated data' to the sampling and assessment sub-model. These simulated data are based on the outputs from the biophysical and exploitation sub-models. The data are then fed into the same assessment models used in the real world, and the output of these is input to a management sub-model. This is typically a set of decision rules and management actions, which can be drawn from an extensive list of fishery management instruments, including: gear restrictions, days at sea, quotas, spatial and temporal zoning, discarding restrictions, size limits, bycatch mitigation, and biomass reference points.

In the present study the lake was partitioned into areas that would represent unique habitats based on their depth, species composition, physico-chemical parameters and exploitation pressure. Based on various attributes the lake was categorized into inshore, coastal and deep strata. Both the inshore and coastal areas were each divided into four strata namely north west (NW), south west (SW), south east (SE) and north west (NW). Six major Islands were mapped out the lake. Another 3 unique strata (Nyanza, Speke and Emin Pasha gulfs) were identified . These 12 regions served as dynamic boxes for the Atlantis model. Additionally 5 major river mouths were mapped as boundary boxes to serve as regions of in and out fluxes of the model domain. The lake was further subdivided in to three water column layers (layer = 0 - 20 m, layer 2= 20 - 4 - 40 m, layer 3 = 40 - 80 m). A total of 41 functional groups are modelled in the Lake Victoria case study. These include 24 fish, 1 bird, 1 reptile, 7 invertebrate, 5 primary producers and 3 detritus groups. Hydrology forcing data was derived from a Regional Oceanographic Model (ROMS). Ultimately, the model output will be used for Lake Victoria Management Strategy Evaluation (MSE).

Some biological characteristics of silver cyprinid, *Rastribeobola argentea* (Pellegrin, 1904) in Lake Victoria, Kenya

Edwine Yongo

LAVICORD

The length-weight relationship, condition factor, Gonadal Somatic Index (GSI), sex ratio, size at first maturity, feeding and food selection of the silver cyprinid, *Rastrineobola argentea* in Lake Victoria will be studied over 8-month period from August, 2014 to April, 2015. About 80 samples of the landed fish will be collected and analyzed monthly from 4 stations; Dunga, Ngegu, Honge and Wichlum stations. For diet analysis, fresh samples will be collected in the selected stations representing shallow areas, midgulf and open waters of the lake. Data on some of the physico-chemical parameters will also be recorded while sampling. The student *t*-test will be used to test whether the value of *b* of the length-weight relationship is equal to 3. Variations in condition factor and GSI will be tested using Kruskal-Wallis test. The Chi-square test will be used to test the null hypothesis that the male to female ratio of the population is 1:1. Size at maturity with be analysed by a logistic model. Cluster Analysis (CA) will be applied to determine how the physico-chemical parameters affect fish distribution.

Aquaculture potential of Nile perch *Lates niloticus:* Food preference and culture

Nicholas Outa[1], Helen Marcial[1], Eric Ogello[2], Priscilla Boera[3], Yoshitaka Sakakura[4], Atsushi Hagiwara[4]

[1] LAVICORD

[2]Kenya Marine and Fisheries Research Institute, Kegati Aquaculture Station, P.O Box 3259, Kisii-40200, Kenya

[3]Kenya Marine and Fisheries Research Institute, Sangoro Aquaculture Research Station, P. O. Box 136-40111, Sangoro, Kenya

[4]Graduate School of Fisheries Science and Environmental Studies, Nagasaki University, Nagasaki, Japan

Nile perch contributes up to 90% of fish exports from Lake Victoria (USD 540 Million annually). However, with the current environmental degradation coupled with over fishing and poor management of the lake's fisheries, there is need to culture the fish in captivity to reduce pressure on the wild stocks. Understanding the feeding behaviour and food preference of any fish being considered for aquaculture is crucial in its culture. We examined 384 of different sizes (1.8 cm to 32 cm TL) of Nile perch caught within the Winam Gulf of Lake Victoria. Small-size (< 10 cm TL) fish fed mostly on zooplankton (>50%). As the fish grows bigger (> 11 cm TL), the food preference changed to small shrimp *Caridina nilotica* and other fish prey including Nile perch. Cannibalism is evident in big fish (> 20 cm TL). Based on these results, we provided small Nile perch cultured in tanks with mixed zooplankton harvested from fertilized fishpond, while bigger Nile perch cultured in hapa nets suspended inside the fishpond with Nile tilapia fingerlings. Survival was low (<50%) a week after transport. Thereafter, no mortality was observed. Mortality is mainly due to cannibalism. Nile perch can be successfully cultured in captivity.

Growth and survival of *Labeo victorianus* fed on different crude protein levels

Dickson O. Owiti[1], Elizabeth O. Obado[2]

[1]Department of Fisheries and Natural resources, School of Agriculture and Food Security Maseno University P. O. Box 333 40105 MASENO, KENYA

[2]LAVICORD

Labeo victorianus (Boulenger, 1901), commonly known as "Ningu*",* is a potamodromous fish native to Lake Victoria basin. The fish supported commercial fisheries in the region in late 1950s and the 1960s but its population declined rapidly and the fishery collapsed afterwards. The present study aims at determining growth and survival of *L. victorianus* fingerlings in captivity using formulated diet made from locally available feed ingredients as protein sources. Hatchery-produced fingerlings (3.78 cm total length; 0.48g body weight) were purchased from Kenya Marine and Fisheries Research Institute (KMFRI), Sagana Station and acclimatized under laboratory conditions for one month before stocking. Feeding experiment is presently conducted at the Maseno University, in hapa nets suspended in concrete ponds (3.5 m x 2.5 m x1 m) under flow-through system at stocking density of 30/m^3.Three experimental diets: D1, D2 and D3 containing 35%, 30% and 27% crude protein, respectively are being tested. Freshwater shrimp, *Caridina sp.* and cotton seed cake, is the main source of animal and plant protein, respectively. The fish are fed at 10% body weight daily, divided into two rations. Sampling for growth parameters is done once a month, while water physico-chemical parameters such pH and temperature are measured daily, while dissolved oxygen, ammonia, nitrites and nitrates, conductivity and total phosphorous are measured weekly.

Co-building a commercial small-scale fish farming model: Through action research partnership with Nyaguta fish farmers, Kisii-Kenya

John Okechi[1], Olivier Mikolasek[2], Safina Musa[3]

[1]Kenya Marine and Fisheries Research Institute, Kisumu Research Centre, P.O Box 1881-40100, Kisumu, Kenya

[2]INTREPID, Department Persyst, Cirad, Ballegurt Campus,TA B-110/A Avenue Agropolis,34398 Montpellier, Cedex 5, France

[3]Kenya Marine and Fisheries Research Institute, Kegati Aquaculture Station, P.O Box 3259, Kisii-40200, Kenya

Small-holder aquaculture in Kenya is slowly picking up from the subsistence level and its development to commercial scale faces a number of constraints; that include access to quality fingerlings and feed, poor pond husbandry and technical management, lack of adequate financial support and poor infrastructure. It is imperative to find solutions to these bottlenecks using strategies based on the experience of commercial aquaculture (running aquaculture as a business), and propose new innovations. This study was initiated to develop a sustainable aquaculture framework in Western Kenya Region (at Nyaguta, Kisii), through Action Research Partnership between researchers and fish farmers. The objectives of the study were: to analyze the socio-economic factors affecting the farmer's decision to adopt fish-farming, to characterize the inputs with the farmers and to describe the farmers' practices, to identify the optimal combination of production factors and determine the farm yields. The farmers' socio-economic factors were collected using a structured questionnaire and through focused group discussions. Inputs used in the ponds were characterized and recorded to the nearest gram. The pond physicochemical parameters were monitored and determined using standard methods. Nile tilapia (*Oreochromis niloticus*) was stocked in 300m^2 ponds at 3 fish/m^2 and fed on pellet feed at 5% body weight over a period of ten months. Semi-quantitative and qualitative data was collected from fifteen ponds over the production cycle. Partial enterprise budgeting was used to compare profitability. From such analysis farmers were able to tell if their ventures were profitable or not. This approach allows for the setting up of a sustainable aquaculture framework adapted to the context of the locality, and proposes opportunities for up-scaling in other regions of the country.

Aquaculture potential of Nile perch *Lates niloticus*: Transport and cannibalism

Yoshitaka Sakakura[1], Helen Marcial[2], Nicholas Outa[2], Erick Ochieng Ogello[3], Atsushi Hagiwara[1]

[1] Graduate School of Fisheries Science and Environmental Studies, Nagasaki University, Nagasaki, Japan

[2] LAVICORD

[3]Kenya Marine and Fisheries Research Institute, Kegati Aquaculture Station, P.O Box 3259, Kisii-40200, Kenya

Optimum size and packing density for the transport of wild-caught Nile perch *Lates niloticus* seed stock for culture in captivity were investigated under actual land transport. Nile perch fingerlings of different size class (2.5-4.0 cm; 5.0-7.0 cm; 8.0-15.0 cm TL) were packed in oxygen pressurized 8-L polythene bags filled with 5-L water at 20, 30, and 50 fish/bag and transported for 4 hours at 25-27^{0}C. Water quality including pH, temperature, total ammonia, and dissolve oxygen were not significantly different before and after 4h of transport. Survival after transport and 7 days thereafter was determined. Small fish (2.5-4.0 cm) were vulnerable to transport stress, registering almost 75% mortality after 4 hours of transport, while bigger fish (5.0 cm and bigger) are resistant to transport (70-100% survival). Mortality in bigger-size group is mainly attributed to cannibalism, while in smaller-size group, death is primarily attributed to stress. Nile perch preyed as high as 90% of its mouth size leading to the death of both predator and prey. Results of experiments showed that transporting Nile perch fingerlings bigger than 4.0 cm at packing density of 10 fish/L is recommended to culturist who wanted to explore the potential of this fish for culture in captivity. In addition, size grading is necessary if fish is cultured in a confined environment (tanks or cages).

Polyculture of *Labeo victorianus* (Bouelenger, 1901) and *Oreochromis niloticus* in earthen ponds

Paul S. Orina [1], Harrison Charo-Karisa[2], Jonathan M. Munguti[1], Pricilla Boera[3], Jacob Abwao[3], Domitilah Kyule[1], Mary Opiyo[1], Helen Marcial[4], Joseph O. Rasowo[5]

[1]Kenya Marine and Fisheries Research Institute, National Aquaculture Research Development and Training Centre, P.O. Box 451-10230, Sagana, Kenya

[2]State Department of Fisheries, P.O. Box 58187-00200, Nairobi, Kenya

[3] Kenya Marine and Fisheries Research Institute, Sangoro Aquaculture Research Station, P. O. Box 136-40111, Pap-Onditi, Kenya

[4]LAVICORD

[5]Moi University, Department of Biological and Physical Sciences, P. O. Box3900-30100, Eldoret, Kenya

A polyculture growth experiment of *Labeo victorianus* and *Oreochromis niloticus* was conducted for 24 weeks in 12 earthen research ponds measuring 450m^2. A monoculture of *L victorianus* and *O. niloticus* were used as controls while a Labeo : Tilapia polyculture ratio of 1:2 and 2:1 were set up using fingerlings of average weight 1g. All treatments were carried out in triplicates and ponds were fertilized using chicken manure. Feeding was done twice a day at 8% body weight throughout the experimental period. Fish sampling was done once a month while water quality was monitored bi-weekly. Treatment T3 (1L:2T) had a significantly ($p < 0.05$) higher survival (L= 49% and T= 87%) as compared to T2 (L= 31% and T= 69%, 2L: 1T). Tilapia monoculture treatment (T4) had a significantly ($p < 0.05$) higher survival and better growth (80%; 79±20.04g) than (T1) Labeo monoculture treatment (50%; 13.12g). There was no significant difference on temperature among treatments in the morning (0600 h) and afternoon (1400 h) over growth period. Dawn (0600) and afternoon (1400) temperatures ranged between 20.16- 24.49 and 23.76- 31.07 respectively with the sampling months of June, July and August recording the lowest. Zero NH_3 was recorded at 1400 h for all treatments throughout the growth period but posted a significantly higher NH_3 in T1 at 0600h. The pH and DO levels at 0600 h and 1400 h recorded significant difference in all treatments. At 0600 h, DO went as low as 2.11 mgL^{-1} and as high as 8.93 mgL^{-1} in T1 at 1400 h. *L. victorianus* slow growth can be associated with the low temperatures and DO levels, there is need to identify other factors that may have contributed to the poor growth. The study recommends *L. victorianus* growth trials in other systems such as race ways and RAS coupled with different feed formulations to come up with an optimal culture system and diet for the fish.

Captive breeding of "Ningu" *Labeo victorianus*

Helen Marcial[1], Nicholas Outa[1], Elijah Kembenya[2], Paul Orina[3], Jonathan Munguti[3], Yoshitaka Sakakura[4], Atsushi Hagiwara[4]

[1] LAVICORD

[2] Kenya Marine and Fisheries Research Institute, Kegati Aquaculture Station, P.O Box 3259, Kisii-40200, Kenya

[3] Kenya Marine and Fisheries Research Institute, National Aquaculture Research Development and Training Centre, P.O. Box 451-10230, Sagana, Kenya

[4] Graduate School of Fisheries Science and Environmental Studies, Nagasaki University, Nagasaki, Japan

Labeo victorianus is one of the threatened endemic fishes of Lake Victoria with requirement of conservation and high potential for culture in captivity. With the aim of enhancing the wild population, we conducted series of experiments in order to breed *L. victorianus* in captivity. Transport experiments in order to determine the most economical and practical way of transporting wild-caught *L. victorianus* broodstocks to culture facilities where they could produce larvae, and subsequently deliver fingerlings to culturist were conducted. Results showed that wild broodstocks (mean body weight = 127.06 g) can be packed as high as 500 g/L and transported as long as 7 hours, while hatchery-bred fingerlings (mean total length = 36.7 mm; mean body weight = 0.46 g) can be packed as high as 60 fish/L, and can be transported as long as 12 hours with minimal to no mortality (0-11.1% mortality rate). Although water quality changed during the transport, it is within the acceptable level for fish survival. Based on the otolith and scales taken from few fish samples, wild broodstocks aged from 3 to 15 years old. Mature broodstocks were induced to spawn using Ovaprim. Mature females (>500 g body weight) can produce as high eggs 86,000 eggs. All spawned eggs hatched at 28˚C (100% hatching rate). The growth rate of larvae fed artificial diet (containing 40% crude protein), newly hatched *Artemia* and mixed zooplanktons harvested from fertilized fishpond was not significantly different from each other. The re-maturation and growth rate, fecundity, and survival of broodstock reared in a raceway and cages suspended inside the fishpond is being investigated.

Prospects of aquaculture in the restoration of the Lake Victoria (Kenya) fisheries: an overview on strategies, status and challenges

Dickson O. Owiti

Department of Fisheries and Natural resources, School of Agriculture and Food Security Maseno University P. O. Box 333 40105 MASENO, KENYA

The human effort in producing fish is a process that is accomplished through hunting in the wild aquatic environment, in the practice of capture fisheries; and also production of fish by the art of culture fisheries. The two methods have had long history of co-existence as means by which humans acquired fish for food. As expected, though, capture fishery would be a much older practice in comparative terms. fish hunting (capture fisheries) may be as old as since the emergence of the ancestry of human species; *Homo habilis*, while the art of aquaculture fish production has been practiced for slightly over 4000 years; starting with tilapia fish culture in Ancient Egypt; and carps, 1000 years later in China. Both traditions, (capture and culture fisheries), have had same goal which is directly, or otherwise, to "put food fish, on the table". The present observation on Kenya's aquaculture as exemplified by the recent events, particularly during the 2008/09 implementation of Economic Stimulus Program (ESP) for the fisheries sector, clearly indicate that culture and capture fisheries are divorced from each other and each seem to be treated as independent entity by the actors in the field of fisheries development. Conversely, there seem to be only some weak connectivity between aquaculture and capture fisheries in terms of administration and support, such that this cooperation/union is hardly considered necessary when it comes to determining the corollary of complementarities that they should afford each other, particularly in terms of dealing with the dwindling stocks in the capture fisheries of Lake Victoria. The use of aquaculture technology to re-culture natural water bodies in the Lake Victoria region has hardly been thought of so far, although an isolated case in the attempts in this regard was recently reported. This presentation advocates that the apparent disjoint should be discontinued and that the two arms of fish production industry in Kenya be supported in unity to meaningfully complement each other towards achieving same goal. This paper reviews the status of aquaculture in relation to problems facing capture fisheries in Lake Victoria and charts possible strategies and way-forward in the two sectors joining forces in addressing these issues. Possible obstacles on this line of thinking is the international status of Lake Victoria.

Improved fish solar dryer using translucent plastic sheets

K. Werimo, A. Mutie, J. Ouko, C. Orinda

Kenya Marine and Fisheries Research Institute, Kisumu Research Centre, P.O Box 1881-40100, Kisumu, Kenya

Fish post harvest losses along Lake Victoria beaches specifically for dagaa is estimated to be over 60% depending on the season. One of the main causes of the loss is the low technology used in sun drying, resulting in high physical loss and contamination of fish product with sand. Further, the drying process is slow, resulting in a product that is of low quality with a short shelf life, consequently financial value loss to fishers. It was therefore essential to identify, test and adapt appropriate technology to shorten drying time, improve product quality and increase shelf life of fishery products. Previous studies had tested a solar dryer made of polyethylene (PE) paper .Though the polyethylene solar dryer was found to be effective in the drying process, its durability was very short due to the effect of sun and wind which were making it to be torn within a period of 1-2 months. This study reports the results of a solar dryer made of plastic translucent sheets compared to the polyethylene paper. The results show that temperature inside drying chamber increased from 26°C to 43ºC compared to that of the polyethylene paper of 26ºC to 39°C. The translucent plastic sheet is therefore significantly effective since it is more durable than the polyethylene paper. In addition the solar dried fish products is of higher quality, with significantly less sand, has firm texture, fresh fish odor, and extended shelf life of over six months. Solar dryers also have lower operating costs than mechanized dryers. In conclusion solar dryers shorten drying time, improve product quality, long shelf life for products, reduce costs and thus improve income to fishers. It is therefore recommended to use translucent plastic sheets for solar dryers to minimize the maintenance costs.

Progress on the value addition of fish from Lake Victoria

Keiko KITO

Center for International Collaborative Research, Nagasaki University

This presentation was to introduce the activity in LAVICORD project dealing with one of the fish preservation technique which established in Japan in 14^{th} Century and its product "Kamaboko", so called "fish paste". The purpose of the activity is to develop the recipe of Kamaboko favorable to Kenyans in order to encourage the consumption of fish through fish paste due to the ease of its consumption without bone or skin and its long shelf life. The gel forming ability of Nile perch and Nile tilapia was examined and shows that both species are acceptable for the fish paste production. The basic recipe has been established and the fish paste with different spices has been tried out. Workshops to spread the techniques shall be held to the local community interested in learning for further project activities.

Preparation and characterization of gelatin from fish scales

Alice Mutie[1], Kohei Yamaguchi[2], Hisashi Ichikawa[2]

[1] Kenya Marine & Fisheries Research Institute, Kisumu Research Centre, P. O.

Box 1881-40100, Kisumu, Kenya

[2] Graduate school of Fisheries Science and Environmental studies, Nagasaki University

Gelatin is a polypeptide obtained by thermal hydrolysis of collagen from animal tissues and is widely used in food, drug and cosmetic industries as stabilizing, thickening and gelling agents. The aim of this research is to prepare and characterize gelatin from two fresh water fishes in L. Victoria namely: *Oreochromis niloticus* (Nile tilapia) and *Lates niloticus* (Nile perch). Extraction of gelatin was achieved by pretreatment of fish scales with 0.1 M HCL and 0.1M NaOH and heating at 80°C for 0.5 or 1hr. Solubilized gelatin was separated from residual scales fragments by filtration, and protein concentration, protein yield, protein composition and breaking strength of cold-set gel were determined. It is established that protein yield and concentration is dependent on ratio of water to scale during extraction. Optimal protein yield (%) and concentration was achieved at water to scale ratio of 2.5:1 where tilapia and Nile perch gelatin attained a protein yield of 45% and 42% respectively and the protein concentration in tilapia was 45.78 mg/ml and 40.0 mg/ml in Nile perch. The highest gel strength of gelatin obtained from tilapia was 1.5 N/cm^2 while in Nile perch it was 5.96 N/cm^2 (at 20 mg/ml of protein concentration). Heating time in relation to gel formability was also determined and it was observed that tilapia gelatin obtained by 1 hr heating showed superior gel forming ability than in the case of half hour heating. Whereas, Nile perch gelatin obtained by 1 hr heating showed inferior gel forming ability than in the case of half hour heating. Moreover, the yield of extracted gelatin was dependant on the size of scales used for instance, Nile perch scale of 8×7 mm average sized sample showed a better yield than a bigger sized scale. When we compare gelatin's gel strength from L. Victoria fish to the strength from Japanese seawater fish and to that of commercial gelatin originating from pig skin, Nile perch scale gelatin and White croaker scale gelatin have same or superior gel forming ability than mammalian gelatin on breaking strength. Fish scale is a by-product derived from fish processing and it is considered as environmental pollutant.Therefore, the fish scales can be used as good material for obtaining highgelling-gelatin for various valuable usages.

Methods for monitoring of fish freshness

Tetsushi Inoue

Graduate school of Fisheries Science and Environmental Studies, Nagasaki University

The development of rapid, low-cost, non-destructive methods for freshness monitoring has been one of the most interesting research fields of food industry over the last decade. The state of freshness can be described by various indices, which are dependent on different biological factors, such as total aerobic count, total volatile basic nitrogen (TVB-N), and K value. These traditional indices have the disadvantage of being destructive, time consuming, requiring highly skilled operators, and unsuitable for on-site monitoring. Among the various alternatives available, impedance spectroscopy is an emerging technique with great potential in food quality control. Impedance has been successfully applied to control fruit ripening, determine water and salt levels in food products, control the quality of ham meat, and detect additives in water or beverages. etc.

In this seminar, I will introduce a device for measurement of impedance. The device enables us to carry out rapid, nondestructive, on-site measurement of impedance of fish. Impedance values can be measured at the frequency of 2, 5, 20, 50, and 100 kHz, respectively. Studies evaluating the possibility of assessing fish freshness by impedance spectroscopy are in the preliminary stage and need to be confirmed using various fish species. The relationship between traditional freshness indices and impedance value should be analyzed using Kenyan fish species to determine the feasibility of evaluating fish freshness based on impedance.

List of participants

Name	Affiliation
Dr. Daisuke Mizoguchi	Head, JSPS Nairobi office
Ms. Chiharu Kamimura	JSPS Nairobi office
Dr. Renison Ruwa	Director, KMFRI
Dr. Enock Wakwabi	Fisheries Scientist / Consultant, Deputy Director, KMFRI Inland Waters Research Division
Dr. William Ojwang	(Former) Senior Assistant Director, KMFRI
Mr. Kenneth Werimo	Senior Assistant Director, KMFRI Kisumu Centre, KMFRI
Ms. Pricilla Boera	Research Officer I, KMFRI
Mr. John Okechi	Research Officer II, KMFRI
Mr. Reuben Omondi	Research Officer, KMFRI
Mr. Jelvas Mwaura	Research Officer, KMFRI
Mr. Collins Ongore	Assistant Research Officer, KMFRI
Ms. Monica Owili	Research Officer II, KMFRI
Mr. Jacob Ojuok	Research Officer I , KMFRI
Mr. Chrisphine Nyamweya	Research Officer II, KMFRI
Mr. Paul Orina	Research Officer II, KMFRI
Ms. Alice Mutie	Research Officer II, KMFRI
Mr. Elijah Kembenya	Assistant Research Officer , KMFRI Kegati Aquaculture Station, KMFRI
Ms. Cecilia Githukia	Research Scientist, KMFRI Kegati Aquaculture Station, KMFRI
Mr. Kevin Obiero	KMFRI
Dr. Dickson Owiti	Lecturer, Department of Fisheries and Natural Resources, Maseno University
Dr. Helen Marcial	Research coordinator, LAVICORD
Mr. Edwine Yongo	Research assistant, LAVICORD
Mr. Nicholas Outa	Research assistant, LAVICORD
Ms. Elizabeth Odera	Research assistant, LAVICORD
Dr. Shigeru Kumagai	Lecturer, Okayama University of Science
Dr. Shigenobu Takeda	Professor, Graduate school of Fisheries Science and Environmental Studies, Nagasaki University
Dr. Yoshitaka Sakakura	Professor, Graduate school of Fisheries Science and Environmental Studies, Nagasaki University
Dr. Tetsushi Inoue	Professor, Graduate school of Fisheries Science and Environmental Studies, Nagasaki University
Dr. Yoshiki Matsushita	Professor, Graduate school of Fisheries Science and Environmental Studies, Nagasaki University
Dr. Yu Umezawa	Associate Professor, Graduate school of Fisheries Science and Environmental Studies, Nagasaki University
Ms. Keiko Kito	Research coordinator,LAVICORD, Center for International Collaborative Research, Nagasaki University

Group photograph