Inception Report

Project Title: **Application of Genetics for Sustainable Exploitation of Narrow-barred Spanish mackerel in Tanzanian Waters**

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Proposed Dates: Start- April 2020 **End – December 2020**

SUMMARY

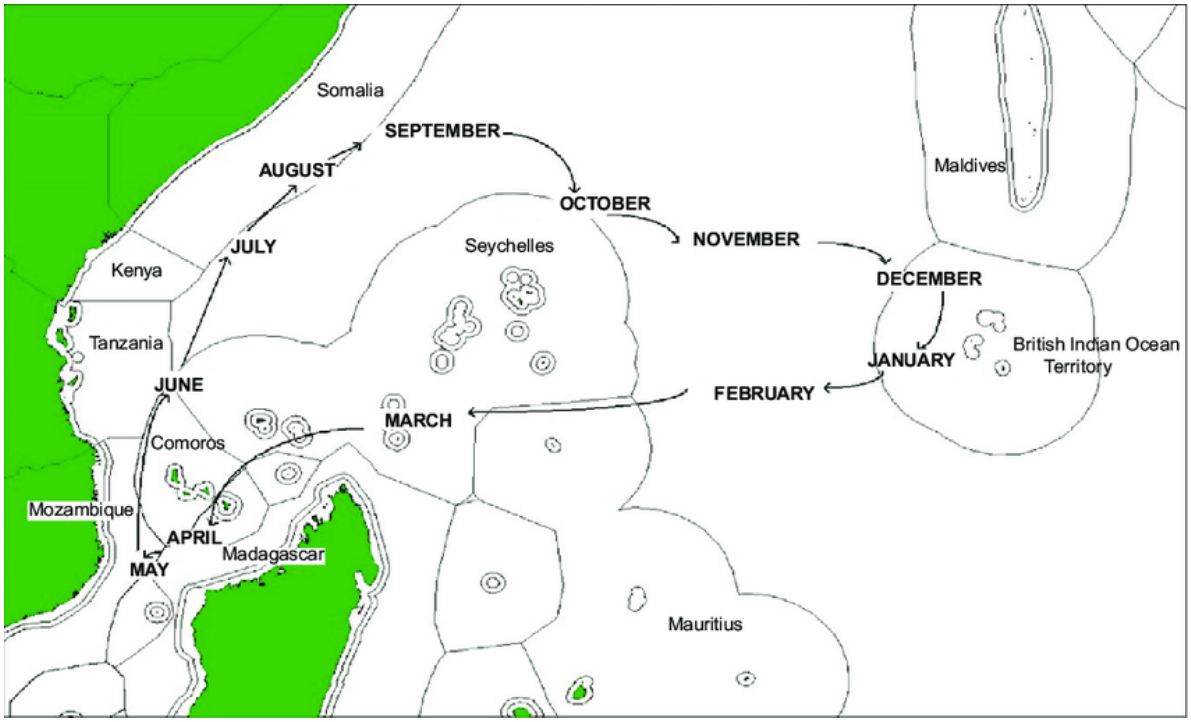
The economic significance of Tuna and tuna like fishery in the Western Indian Ocean (WIO) is well document, and Narrow-barred Spanish mackerel is among the largest fishery, a major source of income and subsistence to the coastal people. And thus; increasing pressure on the fishery intensifies a need to identify its stock structure and reproductive pattern. This study therefore, is in response to **uncertainty surrounding the status of the genetic stock structure** of the Narrow-barred Spanish mackerel in the Tanzanian waters.

Johnson (2016) defined the stock structure and reproductive activity of COM in northern Tanzanian waters. However, uncertainties arouse due to geographical coverage of the study and the actual stock boundaries in relation to the species migration patterns. Johnson (2016) also, observed seasonal variations in the availability and spawning of COM which probably reflects cycles of seasonal aggregation and dispersal in Tanzanian waters, a behaviour that may render the species susceptible to over-fishing.

This project will investigate the genetic structure, stock connectivity and reproductive aspects of COM in Tanzanian waters, specifically by; the project will test the panmixia model which regards all populations as a single random mating entity. The model will be tested by investigating the degree of stock structure and genetic connectivity for the Narrow-barred Spanish mackerel (COM) in the Tanzanian waters and through determining the spawning pattern of the species.

Methods

Study area – Samples will be collected from Mtwara, Tanga and Pemba. These sites are selected due to being highly geographically isolated to carter for analysis of genetic connectivity among different populations, bearing in mind the migratory nature of the species as indicated in the map below.



Western Indian Ocean purse seine tuna fishery. Cyclical pattern of activity by month based upon the European Union purse seine fleet movements. EEZ/Fishery Zones shown. After MRAG Ltd. (2010).

Methods for Objective 1: *To investigate the degree of stock structure and genetic connectivity for the Narrow-barred Spanish mackerel in the Tanzanian waters.*

- ✓ Main activities will include: (A total of 150 individuals will be sampled)
  - ❑ Field collection of fish tissue samples with a minimum of 50 fish samples per site.
  - ❑ Genetic analysis including DNA extraction, PCR and sequencing.
  - ❑ Sequence data analysis for determination of genetic diversity, structure and connectivity; and
  - ❑ Dissemination of the research findings.

Project implementation Plan

Activity	Duration				Expected Results
	Q1	Q2	Q3	Q4	
OUTPUT 1.1 Genetic diversity and stock structure of COM determined					
Collection of fish tissue	xxx				The diversity of the species and its stock structure established
Genome wide extraction, Polymerase Chain Reaction (PCR) and sequencing.		xxx	xxx		
Analysis of sequence data and literature review.			xxx	xxx	
OUTPUT 1.2: Genetic connectivity of COM determined					
Collection of fish tissue	xxx				Genetic connectivity of the species established
Genome wide extraction, Polymerase Chain Reaction (PCR) and sequencing.		xxx	xxx		
Analysis of sequence data and literature review.			xxx	xxx	
OUTPUT 1.3: Contribution of the findings to better management at national and regional authority documented					
Preparation of manuscripts for publication in the peer reviewed journal			xxx	xxx	

Activity	Duration				Expected Results
	Q1	Q2	Q3	Q4	
Preparation of final and progress report		xxx	xxx	xxx	The information gathered solely incorporated into primary literature for management purposes.
Preparation of Policy Brief			xxx	xxx	
Presentation of findings to the stakeholders			xxx	xxx	
Meeting of team of experts	xxx	xxx	xxx	xxx	

Data analysis 1

The filter taxa utility of Macclade (Maddison and Maddison, 1992) will be used to determine the number of haplotypes from sequence data while the **nucleotide diversity** will be estimated in Arlequin v 2.0 (Schneider et al., 2000). Analysis of molecular variance (Excoffier et al., 1992; AMOVA) will be used to estimate the **stock composition with differing geographical groupings** by quantifying the inter- and intra-group component of total variance using Φ - statistics in Arlequin v 2.0 (Schneider et al., 2000). For **stock connectivity**, maximum parsimony trees will be constructed from sequence data using the heuristic (control region) search option of PAUP (Swofford, 1999).

Methods for Objective 2: *To determine the spawning pattern of the Narrow-barred Spanish mackerel.*

- ✓ The following activities will be accomplished: (A total of 300 individuals will be sampled)
  - ❑ Determination of fish sex ratio
  - ❑ Determination of maturity stage and size at first maturity
  - ❑ Determination of Gonadal Somatic Index (GSI)
  - ❑ Determination of timing and frequency of spawning
  - ❑ Determination of spawning fraction
  - ❑ Dissemination of the research findings

Project implementation plan

Activity	Duration				Expected Results
	Q1	Q2	Q3	Q4	
OUTPUT 2.1. OUTPUT 2.1 Spawning pattern and some reproductive aspects of COM determined					
Addition field sampling	xxx	xxx	xxx		Spawning pattern and other reproductive aspects of the species established
Determination of fish sex ratio	xxx	xxx	xxx		
Determination of Maturity stage and size at first maturity		xxx	xxx		
Determination of GSI		xxx	xxx		
Determination of timing and frequency of spawning		xxx	xxx		
Determination of spawning fraction		xxx	xxx		
OUTPUT 2.2: Contribution of the findings to better management at national and regional authority documented					
Preparation of manuscripts for publication in the peer reviewed journal			xxx	xxx	
Preparation of final and progress report		xxx	xxx	xxx	The information gathered solely incorporated into primary literature for management purposes.
Preparation of Policy Brief			xxx	xxx	
Presentation of findings to the stakeholders			xxx	xxx	
Meeting of team of experts	xxx	xxx	xxx	xxx	

Data analysis 2

Reproductive maturity stages will be assessed macroscopically using a six element scheme based on gonad size and appearance as described by Claereboudt et al (2005). Gonad maturation will be categorized histologically using a simplified six-stage description scheme based on Mackie and Lewis (2001). A gono-somatic index (GSI) will be calculated for each fish using the following formula GSI = mass of gonad (g)/gutted fish mass (kg), where mass of gonad is the mass of the fresh gonad, blotted on absorbing paper. The size at first maturity, considered as the size at which 50% of the fish reach reproductive maturity (L_{50}), will be calculated by plotting cumulative maturity probability versus fork

lengths. Spawning frequency (batch interval) will be estimated based on the average daily spawning fraction of mature females showing hydrated ova (assumed day-0 proportion), out of the total mature (active) females (determined macroscopically).

Literature cited

Claereboudt MR, McIlwain JL, Al-Oufi HS and Ambu-Ali AA (2005) Patterns of reproduction and spawning of the kingfish (Scomberomorus commerson, Lacep´ ede) in the ` coastal waters of the Sultanate of Oman. *Fisheries Research 73 (2005) 273–282*

Excoffier L, Smouse P and Quattro J (1992) Analysis of molecular variance inferred from metric distances among DNA haplotypes: Application to human mitochondrial DNA restriction data. *Genetics. 131: 479–491.*

Mackie M and Lewis PAW (2001) Assessment of gonad staging systems and other methods used in the study of the reproductive biology of narrow-barred Spanish mackerel, *Scomberomorus commerson*, in Western Australia. Fisheries Research Report 136, Department of Fisheries, Government of Western Australia, North Beach.

Maddison WP and Maddison DR (1992) MacClade: Analysis of phylogeny and character evolution. Version 3. Sinauer Associates, Sunderland, Massachusetts.

Schneider S, Roessli D and Excoffier L (2000) Arlequin: A software for population genetics data analysis. Version 2.000. Geneva: Genetics and Biometry Laboratory, University of Geneva.

Swofford DL (1999) Phylogenetic Analysis Using Parsimony (and other methods).

PROPOSED BUDGET PLAN

Activity	Unit Measure	Units cost of in put ($)	Number of Units	TOTAL Estimates ($)	Remarks
1. Field work for collection of fish samples for DNA extraction, PCR and Sequencing for COM					
1.1 Man days during field (2 researchers x 3 days x 5sites*4trips)	man-days	60	120	7,200	
1.4 Stationary	lumpsum	300	1	300	
1.6 Transport (fuel for vehicle to Tanga and Mtwara)	litres	2	600	1,200	
1.7 Reagents for DNA Extraction and PCR	Reagents	1500	1	1,500	
1.8. Transport to Pemba (1 researcher*4trips)	air ticket	150	4	600	
1.9. Genetic vials	Vials	100	1	1,000	
1.11 Sequencing of PCR products	copies	150	7	1,050	
			Subtotal 1	**12,850**	
2.0. 2. Field work to collect reproductive information of Narrow-barred Spanish mackerel (COM) in Tanzanian waters					
2.1 Unsorted consumables (material and equipments for field work)	Set	500	2	1,000	
2.2 Fish samples		10	150	1,500	
2.3 Transport and meal allowance for local field assistants (3 assistants*3days*5 sites)	man-days	27	20	540	
2.4 Transport (local taxi + ticket in Tanga and Mtwara)	persons	30	10	300	
2.4 Boat hiring (1 day x 5 site x 2 season)	trip	98	5	490	
			Subtotal 2	**3830**	
3 Data analysis and Dissemination of results					
3.1 Data logging, report writing and analysis	persons	60	10	600	
			Subtotal 3	**600**	
4. Other Costs					
Monitoring and evaluation costs	Interm	60.00	12	720.00	
Administrative cost	Yearly	2,000.00	1	2,000.00	
			Subtotal 4	**2,720.00**	
			Grand total	**20,000.00**	