LITERATURE REVIEW

On

ETHMALOSA FIMBRIATA

(BONGA) STUDIES

IN

THE GAMBIA

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Background information

Bonga has long been among the main source of protein for people in many West African States. Bonga don't only provide food for many West African States, but it is also livelihoods for many engage in fishing, processing, distribution and marketing of bonga and bonga products.It also provides employment for many along Coastal fish landing sites and inland.

Bonga is being exploited to a scale to the extent that the stock has started declining for production has reduced as well as the size of bonga,forcing fishermen using smaller mesh sizes to capture it and sails to longer distance and spent more time fishing .

The level of bonga stock in some West African countries prompted some Organizations/Institutions started addressing the issues on bonga. Among the organizations is the Sub Regional Fisheries Commission that conducted studies on small pelagic including bonga under 3the Small Pelagic Project,

Presently with WWF (World Wide Fund for Nature) " WWF WAMPO " consultcies were awarded to Nationals in Senegal ,Guinea Bissau ,Guinea and The Gambia to review the literature on bonga .

In The Gambia only 4 studies /research on bonga are published and they are:

1. Influence of salinity on life history traits of the bonga shad Ethmalosa fimbriata (Pisces, Clupeidae): comparison between the Gambia and Saloum estuaries;
2. Stock Assessment –bonga studies in The Gambia;
3. Utilisation of bonga: Ethmalosa Fimbriata in West Africa;
4. A Study on Ethmalosa Fimbriata in the Senegambian Region: The Biology of the Ethmolosa in the Gambian Waters.

These 4 studies reviewed were validated on Thursday, 28th August 2014 at the Baobab Holiday Resort in The Gambia. Presnce at the validation workshop were :Mrs.Fatou Sosseh Jallow, Deputy Permanenet Scretary, Ministry of Fisheries who officially closed the workshop, Mr. Alhagie Manjang, WWF Country Coordinator, Mr. Ousainou Touray, Deputy Director, Parks

and Wild life, Members of the National Coordinating Team, Officials from the Fisheries relevant stakeholders and fisherfolks from landing sites along the Atlantic Coast.

Mr Ousman Mass Jobe, Consultant to review the literature on bonga in The Gambia make a power point presentation starting with introduction and on the four documents reviewed.After all the presentations, participants were grouped into 4 to validate each of the topics presented and make recommendations on how to minimize climate change so to increase fish production, create more employment, income and livelihoods.

The workshop was participatory, comments, suggestions and observations are incorporated into the four areas presented as **matters arising** which are more of local knowledge than scientific knowledge. It was obsevered and agreed to review and include other two documents written by Famara Darboe and Ousman Bojang on **biological aspect and fishery of small pelagic off the coast of The Gambia** and that of Matarr Bah and Dawda Saine on **the management plan for the small pelagic fishery in The Gambia**. Both acticles were contracted by the Small Pelagic Project under the Sub-Regional Fisheries Commission and in the report .Hence they were published in 2013, they feature as 1st and 2nd topics in the report .

He stated that Bonga fish is now the second most abundant clupeid in The Gambia after the round and flat sardinela and occurs in inshore waters, lagoons and more than 300 km up rivers (e.g. Gambia River). It feeds by filtering phytoplankton, chiefly diatoms and breeds throughout the year in waters of salinities 3.5-38 ppt, but with peaks in at least some areas. It spawns in the sea, in estuaries and rivers.

Bonga has a dorsal spines, dorsal soft rays 16-19, anal spines, anal soft rays 19-23, upper jaw with distinct median notch, into which tip of lower jaw fits. Lower gill raker long, fine and numerous, about 3 times as long as gill filaments; upper gill raker bent sharply upward in a V shaped. The caudal fin deep chrome, tips long and pointed and a faint dark spot behind gill cover (sometimes followed by others); dorsal fin tip black; golden tints on body its scute is 16-19, pre pelvic fins 10-13 with scales in lateral series of 37-42.

It was also noted by participants that bonga is a migratory species from salt water to fresh water and salt is important to bonga giving it the taste it has. It is among the cheapest source of protein in The Gambia.

Purpose and scope of the consultation

The general objective of this work is to make the state of the fishery bonga Gambia through the documentation available in this country.

Terms of Reference

Bonga scientific name Ethmalosa fimbriata is caught along the coast of the Atlantic Ocean and estuaries in West Africa case.

However, climatic changes in recent decades associated with a full exploitation of the resource have resulted in profound changes in biology, spatial and temporal distribution and socio-economic exploitation of this resource in West Africa and particularly in Senegal and Gambia.

Due to the socio -economic importance of this resource in the regions of Sine-Saloum and Casamance, the USAID WN led between 2009 and 2010 two studies, one on the value chain and study market of this species and the other on the scale transformation. Later in 2012, WWF conducted a study on the impacts of climate change on the bio- ecology of Bonga in the Saloum Delta .

To recap, with more than 80 % of annual landings, Bonga is the main resource exploited in the artisanal fisheries in the Sine -Saloum .

In addition, the IUPA through the USAID / COMFISH project is conducting a study on the selectivity of fishing gear targeting Bonga in the Sine Saloum Delta non notwithstanding the collection of bio data - green on the species.

In conducting this work, USAID Project / COMFISH initiator reflection in partnership with GoWAMER Project, the PRSP and the WWF decided to come together and work together to solve the problem of the resource to the wide range in the ecoregion. Through this work, it is to provide stakeholders and policy makers, a document summarizing all the accumulated knowledge of this resource in the countries of the subregion that are Senegal, Gambia, Guinea Bissau and Guinea.

This work will complement the scientific studies to be conducted by the CRODT Stocks bonga in the context of the implementation of the USAID / Senegal COMFISH project.

Methodology

As a literature review, the methodological was all desk research mainly from the internet. The review on bonga is an overview of previous research /studies conducted by Scholars, Institutions and Organizations.

Biological Aspect and Fishery of Small Pelagic off the Coast of The Gambia

(Famara Darboe and Ousman Bojang 2013)

Introduction

Small pelagic fish stocks including bonga are the most abundant fish species off The Gambian coast which is attributed to existence of upwelling couple with well rich nutrients from the estuary. The canary and Guinea currents (Cold and warm currents respectively) flowing North-South provides favorable hydrological conditions for growth of these stocks which form the basis for the development of other more commercially important fish stocks.

In most states within the Canary Current Large Marine Eco system (CCLME) particularly The Gambia fish particularly Ethmalosa fimbriata is among the main source of protein for the population. Per capita fish consumption along the coast of The Gambia is estimated at 25 kg/year as opposed to only 9kg/year in the rural area.

Objective

Is to improve and understand the dynamics of pelagic fish stocks using data and information on distribution of different species of the stock. The information will be further used to develop a management plan at least at country level. The plan will include guidelines for responsible exploitation of small pelagic. Issues such as impacts of climate change will also be factored in the management plan.

Review

Ethmalosa fimbriata maximum adult population is distributed at a depth of 6- 20 m and distance 4 – 8 nautical miles from the coast. This occurs between June and November. There also exists a lower estuarine population of mainly pre-adults with maximum abundance during dry season (high estuarine salinity period (March-May)

Canoe fishing for small pelagic entirely depend on intensity of seasonal upwelling. Bonga in their shoals are mainly caught at night when they appear on the uppermost layer and their silvery flanks visibly illuminate in the darkness. This phenomenon more elaborately occurs during period of upwelling bringing nutrient- rich water to the top. If West African upwelling is wind-

driven, therefore, the future of bonga fishery will have to be systematically monitored on the background of global weather and Climate change scenarios. It goes without saying that catch volumes of more offshore small pelagic will be higher in years of weak upwelling when lesser nutrient-rich bottom water does not move sufficiently inshore.

There is high degree of unanimity among fishermen interviewed that bonga is the most abundant small pelagic species by both number and biomass, and it is the most heavily exploited by artisanal fisheries. It is very adaptable to environmental change and tolerates wide variation in salinity.

It was revealed that bonga is adaptable to great environmental disturbance (pollution) of both natural and anthropogenic sources. The size at first maturity was found to be inversely related to the extent of pollution of the environment. The authors found large size individuals associated with less polluted waters while smaller size individuals in heavily polluted waters. This is indicative of the species quality as a good bio- indicator of coastal water quality. Its broad distribution, relative abundance, and the fact that its early life history is spent inshore coastal areas (frequent recipient of pollutants) are advantages in the use of E.fimbriata as a bio-indicator in this regard.

Bonga is spatial distribution off The Gambia coast as inshore and closely associated with the estuary. The areal of maximum adult population range between 4 – 8 nautical miles from the coast between the months of June and November at a depth of 6 – 20 metres. Pre - adult population enters the Gambia estuary and distribute from the mouth to upper estuary particularly during the period of relatively low estuarine salinity (January - March).

Migration of bonga into and out of the estuaries is therefore associated with seasonal changes in salinity as well as with abundance of plankton in the estuary during the dry season. For example, is most abundant in the upper estuary during the period March to May i.e at the height of the dry season. During the wet season (May-October) the species again moves down the estuary toward the sea. It is possible that the migration is due to both spawning and feeding needs.

Two size groups can be distinguished in the Gambia waters. These are the immature pre-adult stage and of less than 21 cm long and are restricted to depths of about 2–4 m in estuary. They move further upstream than the bigger fishes during the period of high salinity.

The large size individuals have lengths ranging between 22–33 cm. They are found in areas of the estuary where the water is deeper than 6 m. The population of the two sizes alternate in the areas of distribution.

Maturity is attained at sizes between 22 and 25 cm. small size individuals are caught in the estuary all through the year indicating that breeding occurs all year round and that spawning is highest at the beginning of the dry season and declines progressively but increases again when the wet season sets in and its spawning pattern is due to the spawning area shifting further upstream as the dry season progresses while the increase during the wet season is due to the spawning area moving toward the mouth of the river as the fish return to the sea due to reduced salinity in the estuary.

Conclusion

Small pelagic fisheries of the Gambia under the management of the Department of fisheries is a purse-seine and encircling gillnet fisheries extending some 80 nautical miles north-south and about 50 nautical miles East-West. Currently there are approximately 600 artisanal fishing units targeting Ethmalosa fimbriata, Sardinella aurita, Sardinella maderensis Trachurus trachurus, Trachrus tracae. The stock of these species is shared within the northern CECAF sub region and managed by the individual member states.

Exploitation of these species off the coast of the Gambia is individually managed based on information on catch and effort as well as results of joint pelagic surveys with the member states in the sub region.. It is expected that a collection of data will serve as a useful tool in developing a sound management plan considering the ever-increasing need to conserve the so called last 'healthy' fish stocks of our waters.

Management Plan for the Small Pelagic fishery in The Gambia (Matarr Bah and Dawda F. Saine 2013)

Introduction

The clupeid *Ethmalosa fimbriata (*bonga*)* is abundant along the coast of Western Africa, estuary-dependent and tropical and its distribution is from Mauritania to Angola. Bonga *is* the most abundant small pelagic species by both number and biomass, and it is the most heavily exploited by artisanal fisheries. It is very adaptable to environmental change and tolerates wide variation in salinity and spawns and spends its first year of life inshore (particularly in lagoons) before migrating offshore during its second year.

Bonga is adaptability to great environmental disturbance (pollution) of both natural and anthropogenic sources. The size at first maturity was found to be inversely related to the extent of pollution of the environment and large size individuals associated with less polluted waters while smaller size individuals in heavily polluted waters. This is indicative of the species quality as a good bio indicator of coastal water quality. Its broad distribution, relative abundance, and the fact that its early life history is spent inshore coastal areas (frequent recipient of pollutants) is advantages in the use of bonga *as* a bio-indicator in this regard.

Bonga is spatial distribution off Gambia coast as inshore and closely associated with the estuary. The area of maximum adult population ranges between 4 – 8 nautical miles from the coast between the months of June and November at a depth of 6 – 20 meters. Pre - adult population enters the Gambia estuary. During the period of extreme estuarine salinity the species progress further up the estuary where salinity is relatively lower (March-May). Migration of *E. fimbriata* into and out of the estuaries is therefore associated with seasonal changes in salinity as well as with abundance of plankton in the estuary during the dry season. For example, is most abundant in the upper estuary during the period March to May i.e. at the height of the dry season. During the wet season (May-October) the species again moves down the estuary toward the sea. It is possible that the migration is due to both spawning and feeding needs.

Climate change can affect productivity or the distribution of resources through many pathways: changing water temperatures and precipitation leading to changing currents and upwelling; changing river characteristics and wetlands; extreme events such as flooding and storms, sea level rise and complex relationships between this and other sectors (i.e. water demand from drought conditions). Care must be taken to build adaptively and resilience for the fishing communities through the fisheries management plans and research.

Objective

Is for the development and implementation of small pelagic management plan due to climate change occurring along with its other related climate issues such as ocean warming, sea- level rise, changes in precipitation and increased storminess, these are also compounded by other non-climate related impacts, including over fishing and pollution, which add pressure to the already strained marine ecosystem that provide food for human consumption.

Review

The Gambia Government continues to give high priority to the development of the small pelagic fishery, because it is not only a source of revenue and foreign exchange earnings for the country but also a receptacle of hope for increasing employment opportunities, particularly for women who are involved in fish processing and marketing. The sector is also contributing in improving nutritional dietary in-take of the citizenry, especially in our quest to alleviate poverty and ensure adequate food security.

Fisheries contribute on average 3% of GDP but this has been fluctuating over the years. In 2007, contribution to GDP dropped significantly and has until now not picked up to the 2004/05 levels (see annex table 1). Although this is merely small, yet great importance is attached to the development of the sector as rain fed agriculture based economy is failing.

The small pelagic fisheries sector plays a significant role from a nutritional standpoint and according to the author's estimate the average per capita fish consumption for the period 1994 to 2010 has increased from nearly 25 kg per person to about 28.4 kg per person within the urban and peri-urban areas; representing about 40 to 50% animal protein intake.

The artisanal fisheries in the Gambia faces a lot of challenges particularly the small pelagic: open access, limited information, overfishing/increased fishing capacity of the artisanal, markets, discards, and post-harvest losses, as well as poor sanitary conditions at landing sites. The sustainability and utilization of the small Pelagic will mainly depend on the implementation of the co-management principles and collection of data to manage the fishery. Since fisheries is an economic activity, the small pelagic fishery contribute to this importance in terms of employment creation, income generation, foreign exchange earnings, increased food security and poverty reduction within fishing communities. Artisanal fishing which is dominated by small pelagic operators in The Gambia involves multipurpose activity with a host of ancillary socio-economic activities such as boatbuilding, fish processing, fish retailing to market vendor, Also is the processing sector (smoking and Drying) which is dominated women becomes profitable as managed to own fishing canoes and therefore became owners of a complete fishing unit. The Gambia's artisanal fisheries enjoys a social diversity comprising several ethnic groups, mainly Mandinka, Fula, Wollof, Jola and the remaining distributed among the minority ethnic groups (Creole, Sarahule, Manjako, Serere) .

Fishing has a variety of effects on marine habitats and ecosystems, depending on the spatial extent of fishing, the level of fishing effort, and the types of gear. Market demands both locally and internationally has encouraged fishing efforts to meet this demand. However, declining fish stocks have reduced fishing activities in some areas over the past decade.

Information on small scale fisheries regarding catch and effort data is usually deficient. Over the years, much progress has been registered in the scientific studies of fisheries, marine ecology and oceanography. Despite the accumulation of a great deal of scientific data, there is information to manage the fish stocks, especially those of multi-species fishery.

In these situations, the use of the ecosystem approach to fisheries and fisheries management is recommended, which called for the use of local ecological knowledge of fishermen to manage data deficient fishery and taking into account the collective starting point in order to facilitate the gathering of knowledge for effective planning and for decision-making. Presently there is nothing like predictability in fisheries management, as fisheries is pegged on the uncertainties relating to climate change, ocean acidification, pollution, market demand and overfishing.

Another crucial concept for fisheries management in the absence of reliable is data is learning by doing, otherwise, known as Adaptive management. The adaptive management approach paves for changes in management through evaluation of the management effectiveness on whether actions are meeting the targeted objectives.

If an action did not meet targeted objectives, then fisheries managers must find out as to what the problems are, such as weak implementation or incorrect data, therefore, such situation requires reformulation and development of new actions. Adaptive management requires that decisions be made quickly and actions adjusted accordingly, often before the next fishing season begins. Adaptive management is especially suited for decentralized management contexts and situations were data is not reliable.

Regarding capture fisheries, the systems are decentralized and the use of co-management approach is more capable of adapting to changing conditions. It is strongly recognized and acceptable that, collective starting point with all stakeholders in fisheries management, conservation and development can become more effective and efficient.

As fisheries co-management relates to partnerships arrangement between fisher folks and government, with the share of responsibility and authority for fisheries management. It has several variations ranging from fishermen assigned a minor role to be fully included as major decision-makers, often supporting the science, enforcement, auto-regulation and management of the fishery.

The creation of the NCC and LCCs led to country wide sensitization on the project objectives, the development of a national small pelagic action plan which covered studies relating socio-economic, management and Governance, building and development of capacities of artisanal fisheries operators and biological aspect of small pelagic fishery.

Conclusion

Impacts of Climate change threatening global ecological balance has reversed the current level of understanding of the dynamics of these stocks. Phenomena such as changes in sea surface temperature, ocean circulation, acidification, upwelling intensity, rainfall , river discharge volume etc. that are quite apparent today will justify a routine all-over-start of basic research on small pelagic.

Supportive ecosystems that help to enhance regeneration such as estuaries, mangroves and continental shelve must be conserved to continue functioning. In this regard, the role of Gambia estuary with its mangrove fringes is quite crucial as it is the only normal estuary in the sub region.

Fisheries resources fluctuate as a result of variable environmental conditions. The effects of climate change and possible consequences on fisheries resources and the people who depend upon them are at the forefront of adaptive fisheries management.

Influence of salinity on life history traits of the bonga shad Ethmalosa fimbriata (Pisces, Clupeidae): comparison between the Gambia and Saloum estuaries

(Jacques Panfili1, Jean-Dominique Durand, Abdou Mbow, Bruno Guinand, Khady Diop, Justin Kantoussan, Diaga Thior, Omar T. Thiaw4, Jean-Jacques Albaret1, Raymond Laë 2004).

Introduction

Ethmalosa fimbraita (bonga) life history is influence by many factors including temperature, oxygen and salinity. All these factors are also controlled by climate change; with much rainfall, the intrusion of salt water within the brackish and fresh water is reduced, but with less rainfall, salt water penetrates far inland up to Kuntaur. Some fish can tolerate flatuation of salt content and for bonga was not known until after the study conducted by the Institute of Research and Development based in Dakar Senegal.

Objective

Is to know whether bonga is influence by salinity, environmental stress as the sea and estuaries are subjected to both seasonal modification and long-term climate effect because environmental changes have a direct effect on the life history of fish populations including bonga. Changes in life history can affect reproduction, but also growth, habitat occupation and behaviour.

Review

The study revealed that bonga shad represents a large part of the fish biomass in Senegal and The Gambia estuaries flactuates in different ways. The estuary in The Gambia has a normal salinity gradient, while the Saloum has an inverse gradient. The study conducted in the two ecosystems covered a period 16 months (June 2001 to September 2002) at 5 different locations to investigate the role of salinity on life history traits. The main traits were studied at a spatio-temporal scale: reproduction from macroscopic examination of the gonads, oocyte counting and measuring, and growth from interpretation and measurements of a sub-sample of otoliths.

Bonga is euryhaline specie and can encounter salinity ranging from 5 to 90 ppt and its reproduction occurs mainly in lagoons and estuaries, where they complete their life cycle and spawning is also possible at sea for large adults. Reproduction may be possible throughout the year. Ethmalosa fimbriata tolerates a wide range of salinities from the oligohaline waters of coastal rivers to the hypersaline waters of the Saloum and Casamance estuaries in Senegal.

Previous studies have documented changes in the life history features of bonga with environmental conditions; the average size at first maturity appeared to be very variable among the populations as it ranged between 81 and 84 mm, for males and females and 185 mm for females in the Gambia River.

In trying to understand the effect of water salinity on the life history of bomga, it is essential for a better understanding of the adaptive responses of fish populations to major changes in their environment. The study wanted to understand the impact of salinity in 2 contrasting estuaries in West Africa: the inverse hyperhaline estuary of the Saloum in Senegal, where the highest salinity values are recorded (>130 psu) in the upper reaches, and the estuary of the Gambia River which has a normal salinity gradient, and where the highest salinity values (35 to 45 psu) are located in the lower estuary.

The samples of the study team were collected monthly between June 2001 and September 2002 at 3 locations in the Saloum estuary and at 2 locations in the Gambia estuary. The choice of these locations wer based on salinity gradients; Sibassor being the most saline station and Tendaba the least. Each month, the salinity was measured in situ with a refractometer, and fish sampling was carried out in the commercial landings of the small-scale fishery and directly from local fishermen. The main fishing gear used were purse seines and sometimes ‘kili’ (a small trawl pulled by hand by 2 people) and/or the traps (stownets), in order to obtain the largest size range of bonga. A sub-sample of bonga was used in order to determine the genetic structure of this species in the Gambia and Saloum estuaries.

The total number of bonga sampled was 1405, in Gambia and 1273 in Saloum. The maximum size of the fish was always <300 mm. The commercial landings of bonga are seasonal (from January to June). For this reason gaps are present in the samples over the year. The low salinity during the rainy season also reduced the catch of the individuals during some periods (e.g. August to November, and/or at Tendaba). Finally, for some locations and at particular time of the year, some of the medium size classes between 100 and 180 mm FL were missing.

The ages of bonga in the Gambia and Saloum estuaries were estimated using the interpretation of thin translucent zones on the whole otoliths viewed on a dark background and under reflected light. The alternation of translucent and opaque zones on the whole otolith was sufficiently clear to count them. The zones on the rostrum axis were clearer than on the posterior axis, or any other area of the otolith. The core was translucent, well defined and clearly visible even in the largest fish, surrounded by a first opaque zone which could be composed of thinner opaque and translucent bands. The monthly variation in the relative marginal distance on the otoliths validated that 1 translucent zone was produced per year. This zone appeared during the second part or at the end of the rainy season (October), with a possible shift between the 2 consecutive years (width lower in September 2002), probably linked with the delay of the rainy season.

Matters arising

Salinity has influence on life history of bonga, from August –December more is found in the estuary because of high temperatures and humidity. Salinity content should be balance for easy reproduction and feeding .It was noted that with less salinity bonga returns to marine areas as there is more fresh water in the estuaries during September when there is heavy rains.Bonga become abundant during hamatan December –January .Bonga life cycle is spent most in marine water because high current circulation Bonga that spent more time in fresh water are small with less flesh and white in color

Conclusion

Understanding the factors that explaines the life history variation in the population of bonga living in different habitats may allow us to forecast how this population could respond to changes in their environment. Such understanding may influence management of fisheries that are of national important as Ethmalosa Fimbriata (bonga). The divergence in life history may have 2 origins that can, at least partially, interact: (1) genetic change and (2) phenotypic plasticity. The results illustrate that an environment with high salinity (>60 psu) affects the growth, reduces the size at maturity and increases the fecundity of bonga.

Stock Assessment :bonga studies in The Gambia(Asberr Mendy 2000)

Introduction

Fisheries data is needed to monitor and assess status of the stocks being exploited including bonga. Fish stocks are monitored by catch quotas or efforts and overexploitation of resources may often be detected by a combination of falling catch per unit effort, falling total landings, decreasing mean weight of fish or changes in the fish population age structure or species composition. Overall stock is of greatest importance, the stock status can be more accurately assessed if some account is made of the stock structure, such as age, sex and maturity.

Size and/or age structure provides the critical information on stock structure. Age can be either observed directly through growth rings or derived from size using a growth model. Conversions from size to age frequencies are best accomplished using an age-length key, which is derived from aged sub-samples of the full size frequency. Size composition data are relatively easy to collect by sampling vessel catches. Most often a standardized length measure is recorded.

Objective

The aim of data collection is to monitor and assess the status of bonga that is being exploited.

Review

It was observed that with increasing overexploitation of bonga, it can be detected by a combination of falling catch per unit effort, falling total landings, decreasing mean weight of fish or changes in the fish population age structure or species composition. By maintaining a time series of catch per unit effort and total landings by fleets (e.g. gear or boat category), by commercial species group, fishing area and fishing season, overfishing should be detectable. Without these data, there is often significant disagreement between interested parties because assessments have to be based on subjective judgment and accurate information.

Size and/or age structure provides the critical information on stock structure. Age can be either observed directly through growth rings or derived from size using a growth model. Conversions from size to age frequencies are best accomplished using an age-length key, which is derived from aged sub-samples of the full size frequency. Because of inter-annual changes in growth and reproduction, it is

recommended to establish length-weight relationships and age-length keys for each year, if possible.

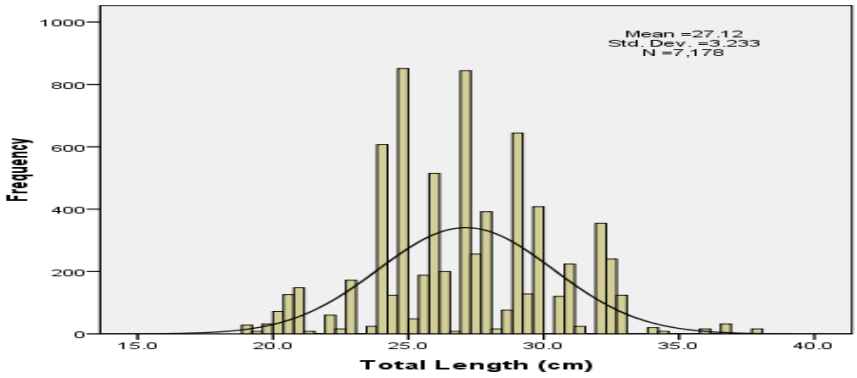
A total sample of 7 178 pieces of Bonga/Shad were measured for total length, a sample size of between 500 and 600 pieces of bonga per month. The total sample (bonga) weight was about 1.5 tonnes compared to total bonga landings of just over 13 700 tonnes in the same period.

Table: Lengt	**2007**										**2008**		
Length Frequency	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Total**
(cms)	**Numbers in the sample**												
19	-	-	24	-	-	-	-	8	-	-	-	10	42
20	-	-	156	-	63	74	-	-	-	-	68	19	379
21	4	45	36	-	84	-	-	8	-	-	-	48	225
22	23	68	72	102	127	29	-	-	-	-	8	86	516
23	133	113	108	-	116	-	80	146	77	98	-	19	891
24	32	113	72	-	95	88	170	227	134	112	17	163	1,222
25	28	227	84	-	43	205	-	16	119	-	42	38	801
26	97	22	48	234	63	118	200	16	203	161	76	19	1,257
27	125	-	-	-	11	-	20	33	-	-	127	-	315
28	60	22	12	198	11	88	140	25	-	168	110	182	1,017
29	-	-	-	-	-	-	-	90	-	-	34	-	124
30	-	-	-	-	-	-	-	25	98	77	17	-	216
31	110	-	-	-	-	-	-	-	-	-	-	-	110
32	-	-	-	78	-	-	-	-	-	-	93	-	171
33	-	-	-	-	-	-	-	8	-	-	-	-	8
34	-	-	-	-	-	-	-	16	-	-	-	-	16
35	-	-	-	-	-	-	-	33	-	-	-	-	33
36	-	-	-	-	-	-	-	16	-	-	-	-	16
Total	612	612	612	612	612	602	610	664	630	616	592	584	7,178
Sample Weight (kg)	122	122	122	122	122	120	122	133	126	123	118	117	1,436

Fish stock assessment based on length structure needs a huge and representative number of samples over a period of time. A twelve month time period would normally show modal transition depicting growth over time and not growth overfish. Three modal lengths of 24 cm, 26 cm and 28 cm were discernable over the twelve months period data was collected.

According to studies conducted by Scheffers, W.J., F. Conand and C. Reizer (1972) and Scheffers, W.J. and F. Conand (1976), *Ethmalosa fimbriata* (Bonga) attains maturity at length between 17 and 19 cm length. With this background information, it could be safely concluded that the bulk of bonga landed within the sample period.

Figure 1: Length Frequency Plot for Bonga/Shad March 2007 – February 2008



Length composition distribution confirmed that over 90 percent of bonga landed from the second quarter of 2007 to the first quarter of 2008 were above 20 cm in length. Studies have shown that Bonga attains maturity between 17 – 19 cm lengths. It could be deduced that the Bonga fishery targets adults. The apparent capture of adult fish is indicative of the selectivity of the gear used, surrounding gillnet.

Matters arising

Data collection is poor and need regular data collection: age/length and life span of bonga, sex etc thus requires regular stock assessment to know total stock and how many are landed or fished. Purse saine nets leads to over exploitation of bonga as the nets catches all types of fish including bonga. Trawlers are also causing problem as they encroach on the artisanal fishing area with their heavy machinery and many violate the regulations on mesh size .

Conclusions

The results indicated that the fishery targets adult bonga and gears employ with mesh size aid in the drive to conserve this species. It should be noted that assessment of stock status proper requires several years of data (time series data); the work presented here is indicative of what some of the results would be like if there was enough length frequency data to conduct full assessment.

Utilization of bonga :Ethmalosa Fimbriata in West Africa (Jallow A.M 1994)

Introduction

Small-scale fisheries account for 80-90 percent of the total catch in West Africa. The catch is made up essentially of small pelagics such as sardinellas, mackerels and bonga. The greater part of the catch is processed because of a lack of good transport infrastructure and scarce refrigeration facilities. The common processing techniques are smoking, salting and drying. These techniques, despite recent efforts to improve them, are mainly traditional. Fish smoking have serious impact to the climate because of immession of heat into the athmosphere.

Objectives

Is to make available bonga fish to many consumers who are not in position of getting fresh because of a lack of good transport infrastructure and scarce refrigeration facilities and also to reduce post harvest losses due to inadequate ice plants and cold rooms.

Review

In West Africa, hot smoking is the main method of fish processing. It is estimated that nearly 70 percent of the total fish supply in West Africa is marketed in the smoked or dried forms, A very significant quantity of this supply is the clupeid bonga. The species is caught in the coastal and estuarine waters, and lagoons along West Africa from Senegal to Cameroon. During the dry season it is caught far inland when salt water penetrates the rivers.

The production and utilization of fresh, dried and smoked bonga was investigated in many countries ,emphasis wasnmade bonga smoking and the marketing of smoked bonga, as this is the major product form in West Africa.

The bonga fishery in The Gambia are along the coast and inland and and is targeted by the artisanal sector operating applying wooden and fibraglass canoes.Some of the canoes are up to 20 m in length with an average crew size of 14.

In The Gambia, encircling/surround gill nets are used to catch bonga and a single canoe can land up to 1 ton per day per trip. The crew members take up different roles at the fishing ground. The ones who pull the lead line are situated at the aft of the net. The others help in throwing out the net when a bonga school is identified by the captain who stands on the bow to distinguish the fish on the surface of the water.

Once a school of bonga is identified, the outboard motor is shut down and the school is approached by paddle. The captain, normally an experienced fisherman, signals to the engine operator when it is appropriate to turn on the engine again. As soon as the engine is turned on, the buoys are thrown out and the encircling is carried out under motor power. The encircled bonga school is then collected in a pocket formed by pulling the lead line of the net. Most of the catch is not gilled in the net and the pocket of bonga is usually poured on board the canoes.

The fishing is carried out by day. Some units return to their landing sites after only one satisfactory operation. When the operation (one school encirclement) is not entirely satisfactory, the captain may order up to two or more. Except for the removal of some of the gilled bonga from the net, there is no handling of the catch between the fishing ground and the landing site. Upon arrival at the landing site, the canoe is swarmed by fishmongers - who buy and distribute fresh bonga - and processors - who dry or smoke the bonga.

. Bonga has become so important in the urban diet in The Gambia that some fish traders are using ice and a chill room at Bakau to preserve fresh bonga that is landed late, for the daily morning markets in the heavily populated towns of Bakau and Serrekunda. The demand for fresh bonga in these major markets is so high that the traders can afford the costs of storage in the coldroom since they recover these costs.

In West Africa, bonga is consumed fresh, smoked, cooked, salted and dried, or fermented, salted and

dried. Food habits, purchasing power, and infrastructural facilities influence the type of product in particular areas. In the past, very little bonga could be marketed fresh and the fish had to be preserved for wider distribution.

This study identified hot smoking of bonga as the main method of bonga processing in the The Gambia. The fermenting, salting and sun-drying of bonga occurs only in Senegal and The Gambia. Roasting, salting and drying (ketiakh) occur in Senegal only.

Smoking is a method of fish preservation that combines three effects:

- extraction of moisture by the heat generated by the fire causes the drying that inhibits most spoilage organisms;
- smoke from the burning wood preserves the bonga because it contains a large number of compounds, e.g., phenols, that can kill bacteria which may cause spoilage;
- Cooking the fish flesh at a high temperature kills bacteria and destroys harmful enzymes.

However, the long storage life of the smoked bonga is due more to the cooking and drying than to the phenols in the smoke.

Smoked bonga is the most popular bonga product in West Africa. The species is harvested in increasingly large numbers and smoking seems to be the best way of preserving the catch, in particular, in the more humid areas between The Gambia and Angola. The catch is generally unloaded from the canoes into baskets, boxes, or plastic basins and either dumped on the beach or transported directly to the smoking houses. Once the bartering ends and the sale is concluded, the bonga is either rinsed or placed directly on the rack of the oven being used. Bonga that has gathered sand when being landed on the beach is usually rinsed before smoking.

In West Africa, local conditions and availability of materials have dictated the design of smoking ovens. The ovens range from the open traditional banda, the covered banda (with flattened barrel metal sheets), the barrel ovens, the mud block covered banda ("Fante"), the Chorkor, to the now modified

Chorkor ovens. Despite the variations in the design and materials used, the raw material is invariably fresh, ungutted and unscaled whole bonga and the smoking process invariably consists of a cooking phase in which the raw fish is cooked over a high fire and a more or less long drying phase over a low fire.

In The Gambia a closed banda oven has been developed with partition walls inside in order to ensure that the traditional bonga smoking methods are improved to reduce fuelwood consumption and create a better environment for the processors the appropriate technology is required. A fire box (smoking chamber) that can be closed to reduce heat loss and conserve fuelwood and a fixed grill or wire mesh platform for stacking large quantities of bonga for smoke-drying is needed. The appropriate technology was achieved in The Gambia through consultation with the smokers and it is called the "Improved Chorkor Oven".

Improved Chorkor oven

Matters arising

Ultilisation of bonga enchanced livelihoods and increase earnings. It helps in foreign export earings and contributes in poutry farming. Smoke bonga reduces hunger because is affordable.

Conclusion

Bonga (*Ethmalosa fimbriata*) is a very valuable commercial species for the fisheries of The Gambia. This pelagic species, landed in large quantities along the coast, reaches a large segment of the rural population who are the main target group for nutritional improvement within many national food

security policies. Harvesting and processing of bonga also provide income for families who can use the net income to improve their living standards.

The production of cheaply processed products requires an appropriate, efficient and low-cost technology. The salting and drying technique has so far proved suitable for the product requirement and working conditions. Ssmoking techniques vary a lot and differ in convenience, efficiency, and costs; which puts the spotlight on the improvement of the less efficient techniques being used in the sub-region. A suitable technology and working environment, albeit can be further improved, have been identified in the modified Chorkor oven. Therefore, the modified Chorkor oven is the bonga smoking technology for West Africa, where the bonga landings are increasing and the smoked product is the most popular with the consumers.

A study on Ethmalosa Fimbriata in the Senegambian Region: The Biology of the Ethmolosa in the Gambian Waters (BOWDICH 1979)

Introduction

In the Senegambian region, landings of bonga by the artisanal fisheries are very important and represent a yearly production of about 25,000 tons. The biggest part of the catch is for fresh consumption the rest is smoked or dried. Landings and samples of bonga analysed and plankton surveys effected, in different stations in Senegal and The Gambia.

Objective

To evaluate the coastal pelagic fish stock and to study its

Review

Hydrologically The Gambian waters have the same pattern as the Senegalese waters and have three hydrological seasons can be distinguished.

The cold and saline water season "upwelling waters" December – April and the warm and saline water season "tropical waters" May – Septamber Temperature less than 24°C.

The warm and, unsaline water season "guinean waters" Octobrer – November.The cold season, from December to April, is influenced by the trade winds which are during these months weIl established

and blow very regularly. They induce along the coast south from Dakar a strong upwelling which moves up saline and cold waters with the characteristics of Central South Atlantic. In July when the trade winds blow irregularly and finally end, they are replaced by the tropical waters which cover the whole continental shelf in JuIy. From September the "tropical waters" are removed by the "guinean waters". Coming from the South. In November the cooling of the water begins with the arrivaI of the trade winds and the coastal upwelling and in December the "guinean waters" are pushed off-shore and to the South.

The hydrology of the river Cambia has been studied by the Project "Hydrological and topographical studies in the Gambian river bassin" (l~DP/ü/OTC, Rer 60). The river Cambia has its source in the Fouta Djallon in Guinea and its total length is 1100 km. The flow of the river is of a pure tropical type with a period of high water from July to November and a period of low water from Januory ta June when the flow is neglible. Civen the topogrophy of the estuary, the saline water penetrates very deep during the low water periods; in Ballingho (13!: km) the salinity in June 1979, was about 22 in Kanikunda about 13 the boundary moved up till 260 km. With the moment of the flood the brackish water is pushed back to the sea.

Semples of Ethmalosa fimbriata mainly from gill nets were taken every month from canoe fishery landings at Atlantic coast of the Gambie and from the river durinr the period September 1970-71. Length frequencies (fork length at one cm below). The gonads were weighed, and their maturity stages determined according to the scale of bonga, In 1971 and 1973, in the same areas irregular sampling has been done and only length frequencies were made and maturity stages noted. The results of the analyses were grouped for the Atlantic coastal area and for the river.

The feeding area of the river is rather limited and the competition for food with other species will be higher. The values of K for individuels from the river may be for this reason lower than the ones from the sea. The most important reason for the migration up river seems to be the reproduction in the spawning places of the river.

Monthly sex ratios (percentcges) of bonga sampled in the coastal areas show a predominance of females from November to February, and of males from July to September. In semples from the river monthly length frequencies (percentage) of Etlanalosa Fimbriata from different places along tbe river

Gambia, the females are more abundant from march to July, while in February the males dominate.

Due to their rapid growth, the larvae are only caught by plankton net during a small period of their life; between hatching and about a fortnight. Their presence and abundance is therefore a good index of reproduction and its intensity in the region.

Monthly percentages of different maturity stages of bonga from samples of the coastal area and the river Gambia.Two types of variation are possible, one connected witn the hour, the tidal current, and the lunar period of collecting, the other with seasonal and geographical variations.

Collections of plankton in Banjul have been done monthly in 1975 at the time of new moon. For each night of collecting, the number of larvae of ethmalosa caught every two hours is analysed. An analysis of variance shows that there is no evidence at the 95 percent of confidence level, for the catch to be dependent on the hour.

The results are given for 011 fish larvae concerning the ethmolosa can be pointed out that :

In **Banju**l the reproduction is continous from December- February (T-< 23°C; S> 35), and with periodical peaks in March, June-July and October-November. The region of the estuary with mixing waters may be a good nursery ground for the species.

In **Tankular** the number of ethmalosa larvae was always low, and with the arrivaI of the fresh water from July - August, they disappear completely.

In **Balingho** during the first surveys in February the larvae of bonga were abundant. The water temperature was at that time 23-24°C and the salinity of the surface water about 10 %o. The peak of abundance occures in July, one month earlier than in Banjul , in waters with temperature of about 20°C and salinity about 20 %0 .

In **Kani kunda** the collection has been done only from May to July at the maximum of saline water penetration. In June we found the larvae monthly abundance of ethrnalosa larvae and surface

observations of temperature and salinity of ethmalosa mixed with the pellonula. At that time the salinity was above 10 ppt.

In the coastal area, females in post-spawning stages first appears only in September which indicate a partial spawning of the females before that time. The individuals around 18 cm which arrive at first maturation do not participate in the spring spawning period according to gonado-somatic index cycle.

Matters arising

Tropical water now occurs earlier than September and it occurrence depends on rainfall. From September – November salt water penetrates to deeper sea .Maturity of bonga could also be attributed to tidal period's .More rains more fish as it contribute to salinity of the sea.

Conclusion

The results concerning the ethmalosa population in the Saint Louis region are compared with the ones of the present paper. The length-weight relationship is very similar in spite of the differ ence in the sea water temperature.

- Both populations show the same anadromous migration during the intrusion of the seawater in the dry season.

- The sex ratio for both populations is very close to 1.

- The minimal reproduction length was 17 cm for the females and 15 cm for the males, in Saint Louis. For The Gambian area however the minimal reproduction length for the females was 18 cm.

- The spawning begins in both areas, in the river, and longs until the arrivaI of the flood. In the estuary and in the seo the spawning continues the whole year round with a minimum during the cold season (December to february).

- Spawning takes place in water with salinity between 3.5-38 ppt

Recommendations

- Ban 30mm mesh size for bonga and use 36mm-40m mesh size for both bonga and sardinela
- Develop a bonga and sardinela management plan
- Conduct risks based assessment on bonga stock
- Ban night fishing as in Senegal
- Capacity for Researchers, fishers and Fisheries Department staff on stock assessment collection of catch data, participatory monitoring, control and surveillance
- Conducting regular stock and catch assessment
- The usage of purse saines should critically be looked into as lead to over exploration
- Trawlers encroachment into the artisanal sector also poses problems because of the noise from their engines
- Planting more tress to be getting more rains as more rains result in more fish
- Serious reduction on deforestation
- More market outlets for the smoke bonga
- Better management measures on the bonga resources
- Reduction on fishing efforts
- Storage facilities
- Transformation /processing of bonga (value added
- Continuous survey on seasonality of water

References

Albaret JJ (1999) Les peuplements des estuaires et des lagunes. In: Lévêque C, Paugy D (eds) Les poissons des eaux continentales africaines.

Albaret JJ, Gerlotto F (1976) Biologie de l'ethmalose (Ethmalosa fimbriata Bowdich) en Côte d'Ivoire. I. Description de la reproduction et des premiers stades lar- vaires. Doc Sci Cent Rech Océanogr Abidjan VII (1): 113–133 Albaret JJ, Simier M, Darboe FS, Ecoutin JM, Raffray J, Tito de Morais L (2004) Fish diversity and distribution in the Gambia Estuary, West Africa, in relation to environmental variables.

Alh.Cherno O. Joof and Alh.Ebou M. Mbye (2012), Building and Development of capacities of Artisanal Fisheries Operators on the Small Pelagic Fishery in The Gambia.

Asberr N. Mendy and Mr. HamadyDiop (2012), The Sardinella of Northwest Africa Fisheries, stock Assessment and Management

Aquat Living Resour 17:75–85 Leberg P (2002) Estimating allelic richness: effects of sample size and bottlenecks. Mol Ecol 11:2445–2449 Legendre M, Ecoutin JM (1989),

AUBRAY P., 1975.- The Fishery of Gambie - a comprehensive report. Banjul – Rome,

Bellemans, M., A. Sagna, W. Fischer, and N. Scialabba. 1988. Guide des ressources halieutiques du Sénégal et de la Gambie (Espèces marines et d'eaux saumâtres). FAO, Rome. 1988,

Bigelow, H.B., M.G.Bradbury, J.R. Dymond, J.R. Greeley, S.F. Hildebrand, G.W. Mead, R.R. Miller, L.R. Rivas, W.L. Schroeder, R.D. Suttkus and V.D. Vladykov

Biology of Ethmalosa fimbri- ata (Bowdich) and fish diversity in the Ebrie Lagoon (Ivory Coast), a multipolluted environment. ICES J Mar Sci 60: 259–267 Hare MP, Palumbi SR (2003),

Charles-Dominique E (1982) Exposé synoptique des données biologiques sur l'ethmalose (Ethmalosa fimbriata S. Bowdich, 1825). Rev Hydrobiol Trop 15:373–397 (1998),

Durand, M.H. 1981. Aspects socio-économiques de la transformation artisanale du poisson de mer au Sénégal. CRODT, Dakar, Sénégal,

Examining evidence of reproductive isolation in sockeye salmon. Science 291:1853 Iwama GK, Takemura A, Takano K (1997) Oxygen consump- tion rates of tilapia in fresh water, sea water and hyper- saline sea water. J Fish Biol 51:886–894 Jarne P, Lagoda PJL (1996) Microsatellite, from molecules to populations and back. Trends Ecol Evol 11:424–42,

E.M. Mbye 2012 Survey of the small Pelagic fish resources in the waters of Guinea, Guinea BissauSenegal and The gambia (June – July 2011,

Famara Darboe &Mr. Ousman Bojang (2012), Report on the Biological Aspects and Fishery of Small Pelagics OFF the Coast of The Gambia

Fishes of the western North Atlantic. Part three. New Haven, Sears Found. Mar. Res., Yale Univ. 1963),

FAO Report No. 1026 Ref. FIRF/R1026 (Bi)FAO Working Group on the Assessment of Small Pelagic Fish OFF Northwest Africa, 2011

FAO\Fridtjof Nansen Programme on the Small Pelagic Northwest Africa,

Fishes as indicators of environ- mental and ecological changes within estuaries: a review of progress and some suggestions for the future. J Fish Biol 61:229–250 Wright S (1951) The genetical structure of

populations. Ann Eugen 15:323–35

Fishery Co-Management Plan For The Gambia Sole Complex (focus on artisanal fisheries sub-sector) January 2012,

Gerlotto, F. 1979. Biologie de Ethmalosa fimbriata (BOWDICH) en Côte d'Ivoire III - Etude des migrations en lagune Ebrié. Doc. Scient. Centre Rech. Océanogr. Abidjan Vol.X, No.2, décembre, 1979 : 3-41. CRO, B.P V18, Abidjan, Côte d'Ivoire,

Genetic variation and conservation of stream fishes: influence of ecology, life history, and water quality. Can J Fish Aquat Sci 54: 1822–1836 Hendry AP (2002) QST > = <> < FST? Trends Ecol Evol 17:502 Hesthagen T, Jonsson B (2002) ,

High intron sequence conserva- tion across three mammalian orders suggests functional,

Hydrological and topographical studies of the Gambia river basin". Project UNDP Réf. 40360. (Howard Humphrey &Sons, Consulting engineers, Reading England) 1974..

Jallow, A.M. 1992. Fish smoking in The Gambia: Fuel efficiency study. The IDAF Newsletter, December 1992 No. 16. IDAF, Cotonou, Benin,

Kimura DK (1980) Likelihood methods for the Von Bertalanffy growth curve. Fish Bull 77:765–776 King RP (1997)

Levesque, P. 1992. Expérimentations de nouvelles techniques (four Chorkor) et améliorations de techniques existantes (four parpaing et au sol). Pro-Pêche composante ATEPAS, secteur transformation. Document technique sur les pêches, No.8. Ministère Délégué charge de la mer, Dakar, Sénégal,

Mr. Benedict P. Satia, (2013), Strategic Direction for Promoting the Sustainable Exploitation and Cooperative Management of the Small Pelagic Fishery of Northwest Africa

Mr. Matarr Bah and Mr. Dawda F. Saine (2012), Report on the Socio- economic study on the Small pelagic fishery in Gambia

Mr. NfamaraJerroDampha, (2012), Study to Review the Status of the Management and Governance of Small Pelagic in The GambiaProgramme for Accelerated Growth and Employment (PAGE) 2012 –

2015

Scheffers, W.J. and F. Conand, 1976. A study on *Ethmalosa fimbriata* (Bowdich) in the Senegambian region. 3rd note: the biology of *Ethmalosa* in the Gambian waters. Doc. sci. prov. Centre Rech. Océanography. Dakar-Thiaroye, ORSTOM, 44:21,

Scheffers , 1971.- Note préliminaire sur quelque!; aspects de la biolo- cie de Ethamlosa fimbriGta (Bowdich)

Scheffers , 1975.- Hydrological surface observations in Bakau (Atlantic coast) and in different places a10ng the river Gambia.

Scheffers ., Ja~E5 A., 1976.- hydrological surface observations in Bakau on the Southern atlantic coast, and in Banjul on the estuary of the river Gambia during 1975. Project U~~F/FAQ GA~1 73006 Fisheries. Division. Banjul. Fisheries

Scheffers W.J., Taylor Thomas, 1974.- Data on landings of Ethmalosa fimbriata by the artisanal fishery in three villages along the Southern Atlantic coast of the Gambie, during the period November 1973, to April 1974.

Seventeen new exon-primed intron-crossing polymerase chain reaction amplifiable introns in fish. Mol Ecol Notes 2:334–340 Heithaus MR, Laushman RH (1997)

Suitability of brackish water tilapia species from the Ivory Coast for lagoon aquacul- ture. I. Reproduction. Aquat Living Resour 2:71–79 Lévêque C, Paugy D (1999)

. Tettey, E.O and M. Njie. 1992. Cured fish export trade from Gunjur (Gambia) to Nzerekore (Guinea): challenges and opportunities. Bonga Reportage, Volume II, April 1992 - INFOPECHE. Abidjan, Côte d'Ivoire.

Webb and Grant (1979), Stevens and Hausfeld (1982) and Jordan (1994)

The Gambia Government Vision 202