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SHORT COMMUNICATION

GEOMORPHOLOGICAL POTENTIAL OF COELACANTH HABITAT ACROSS MOZAMBIQUE-TANZANIA BORDER

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ABSTRACT

The coelacanth is a new fish in Tanzania. It was first discovered in September 2003 after it was spotted by a tourist in a fish market. It was caught by fishermen in the deep waters off Songo Mnara Island offshore of Kilwa Masoko Town in Southern Tanzania. The find potentially added southern Tanzania to the list of known coelacanth areas of the southern Western Indian Ocean Region. Observed current conditions indicate that the waters are swept by strong (2 m/sec) northward flowing current. This suggests that there must exist hideouts for the fish, such as caves in canyons and overhangs. Carefully analysed single cruise bathymetric data obtained from the region indicate existence of canyons off the Tanzania- Mozambique border region, which are believed to provide habitat to the fish. The data point to the potential of the area as habitat for the elusive coelacanth.

INTRODUCTION

Following rediscovery of a living coelacanth in St Lucia Marine Park in Sodwana Bay in South Africa, the Government of South Africa started a major effort to find and conserve the fish. In the effort it was felt in the scientific community that the whole of the southern western Indian Ocean region from South Africa to Kenya should be explored. Tanzania joined the regional effort that came to be referred to as the African Coelacanth Ecosystem Programme (ACEP), starting with awareness campaigns among the fishing community, schools and the scientific community and joining the first cruise run by the Programme from South Africa northwards to Tanzania in July 2003. The coelacanth was first discovered in Tanzania in September 2003 after it was landed by fishermen fishing in the deep waters off Songo Mnara Island offshore of Kilwa Masoko Town in Southern Tanzania. As the fishermen were not familiar with the fish, they tried to prepare it (gutting and salting) ready for sale in areas afar. It was salvaged by scientists after a tourist spotted it in the market and information was relayed about the find. A second specimen was landed in the same area in March 2004. These events led to further intensification of scientific interest in the fish biology, history and the oceanography. A third specimen was landed in the same area in Sept 2004.

Coelacanth is a member of a group of fish known as the *crossopterygii,* which became extinct towards the end of the Cretaceous Period some 65-70 million years ago (ma). They are well known from fossil records dating as far back as the Devonian Period about some 410 ma. Many of the fossil forms are known to have dwelled in fresh waters and have been recorded on all continents except Antarctica. In 1938 the fish was rediscovered after it was landed at East London in South Africa by a trawl boat (Smith 1939). Scientists embarked on a search for the next specimen, at one point

offering a reward of British Pounds 100, and a second one was found in the Comoro Islands in 1952. After the Comoros provided most of the known caught specimens this has been considered to be the home of the coelacanth (Balon *et al*. 1988, Bruton 1989, Bruton *et al*. 1992, Hissman *et al*. 1998). But to date there are confirmed populations in South Africa in rather different geomorphologic setting involving caves and offshore canyons. On the basis of the known habitat conditions, this paper evaluates the potential of the southern Tanzania area bordering Mozambique for coelacanth habitat.

COELACANTH DISCOVERY

Living Coelacanth (*Latimeria* ssp) has been landed by fishermen in various parts of the Western Indian Ocean shoreline since the first landing was recorded at East London, South Africa in 1938. Confirmed discoveries have been reported from South Africa, Comoro Islands, Mozambique, Madagascar, Indonesia, Kenya, and recently in Tanzania (Table 1). Many of the first catches appear to have been by trawl nets or gill nets, both of which, are cast on less rugged sea bottoms. Such isolated incidents appear to be accidental capture, a view that has long lead to further search for the fish in its natural habitat. Using dives and submersibles, scientists have eventually established that the fish lives in deep water caves (Table 2).

Table 1: Known first landing of coelacanth in countries around the WIO region. The questionmark indicates local non commercial vessel.

Year	Landing	Bottom type	Fishery type	Vessel Name	Source
1938	East London, S. Africa	Rocky	Trawl	Nerine	Smith 1939
1952	--, Comoro	Volcanic slopes	Lining	?	Dinofish.com
1991	Pebane, Mozambique	Sandy	Trawl	Vega	Bruton *et al.* 1992
1995	Toliara, Madagascar	Sandy	Shark net	?	Gombess.tripod .com
1997	Sulaweshi, Indonesia	?	Shark nets	?	Fricke *et al*. 2000
2001	Malindi, Kenya	?	Trawl	MV Venture	Dinofish.com
2003	Kilwa Masoko, Tanzania	?	Lining	?	ACEP

Table 2: Known habitat types of the coelacanth.

Year	Place	Observation	Habitat type	Depth (m)	Source
1987	Comoro Islands	Submersible	Caves and overhangs	250 - 300	Fricke *et al*. 1991
1998	Indonesia	Submersible	Carbonate caves	155	Fricke *et al*. 2000
2000	St. Lucia, S. Africa	Mixed air dive	Caves	104	Venter *et al.* 2000
2002/3/4	St. Lucia, S. Africa	Submersible	Caves in Canyons	104 - 148	Venter *et al.* 2000

COELACANTH HABITAT

The caves in which the fish has been found along the eastern coast of Africa are located within deep canyons (Venter *et al*. 2000). If the location of these geologic features akin to the coelacanth habitat were precisely known it would be easy to search for the fish anywhere. A survey of the existing charts however, shows that the scale is so small that these features are not easily recognised. Along the eastern coast of Africa, canyon heads seem to occur along the South African coast northwards to southern Tanzania (Fg. 1a). These have been mapped in detail along the St Lucia Marine Park up to the South African border with Mozambique (Green *et al*. 2007). Canyon identification has been important in planning subsequent dives for the coelacanth search with submersibles. Although there is no submarine canyons known off the Tanzanian coast, the recent multiple catch of the coelacanth from the same location suggests existence of these geologic features. The hypothesis is that either, there exists deep canyons within which, caves provide hideouts for the fish or else the necessary deep water caves must be associated with steep coral reef slopes as it has been observed in Indonesia. In Comoro islands for instance the caves are found within overhangs on the steep slopes of the volcanic islands. The only other alternative is that the fish being a sluggish swimmer was caught while drifting with the current away from its natural habitat that is not located along the Tanzanian coast. The paper presents the first evidence for the existence of canyons off the southern coast of Tanzania.

HABITAT SEARCH - CANYONS

Following the coelacanth discovery in 2000 in Great St. Lucia Park and subsequent launch of the ACEP (the African Coelacanth Ecosystem Programme) research and conservation programme, a cruise was organised with the FRV Algoa in July 2003 along the coastline of the Southern Western Indian Ocean region. During the cruise across the border region between Mozambique and Tanzania on 26 July 2003 effort was made to monitor the canyons and currents. Depth records from the ship's depth sounder were taken every minute along with ship speed while the ship took a shore parallel course (Table 3). Cross canyon distance was estimated from the product of the vessel's speed and time interval taken to cross the canyon. Currents were observed from the ship-mounted ADCP (Acoustic Doppler Current Profiler), which due to some technical difficulties, only the shallow beams gave reliable readings (Table 4). Google earth (2007) maps were assessed for shoreline geomorphology while GEBCO data were used to obtain the bathymetry of the border region (Fig. 1b).

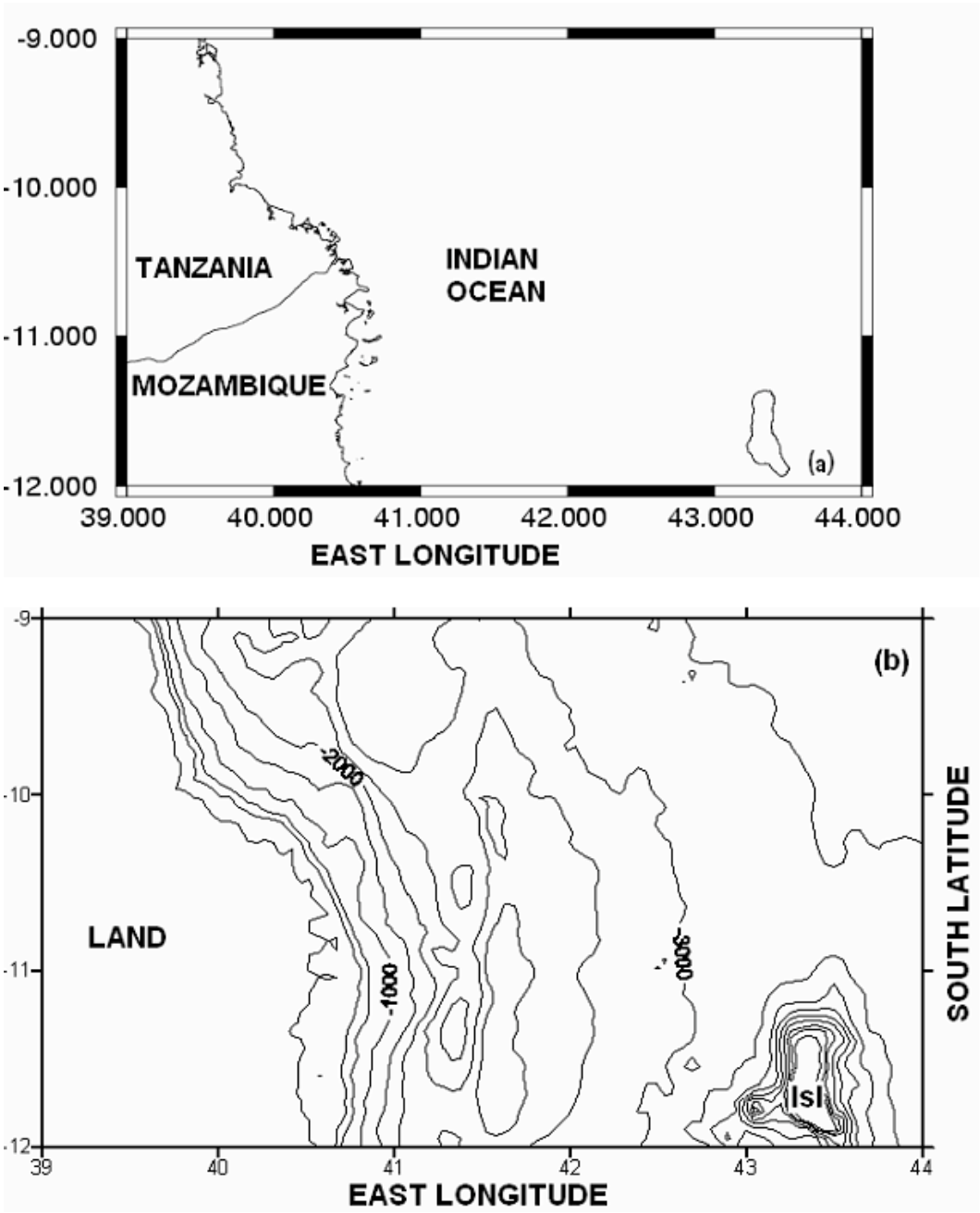

Figure 1: The coastal outline of the border region between Mozambique and Tanzania showing signs of canyon heads (a) and the general bathymetry (b).

Table 3: Sample of ship speed and depth record across Tanzania-Mozambique border region, 26 July 2003

Time(Hr:min)	Speed (kn)	Depth (m)	Time(Hr:min)	Speed (kn)	Depth (m)
12:14	11,3	443	13:43	11,7	801
12:16	11,3	452	13:44	11,8	798
12:19	11,2	647	13:44,5	11,8	738
12:21	11	581	13:45	11,8	722
12:27	11,1	465	13:49	11,8	507
12:28	11,1	538	13:51	11,8	496
12:34	11,1	477	13:52	12	502
12:39	11,5	490	13:52,5	12,1	509
12:40	11,75	520	13:53	11,9	517
12:42	11,9	639	13:55	11,6	559
12:42,5	11,7	561	13:56	11,5	541
12:43	11,9	562	13:57	11,5	528
12:43,5	11,9	547	14:02	11,5	493
12:46	11,8	493	14:07	11,9	536
12:59	11,8	523	14:09	11,9	709
13:04	12	534	14:10	11,7	524
13:06	11,8	508	14:11,5	11,9	506
13:20	11,7	540	14:12	11,9	553
13:23	11,8	657	14:12,5	11,8	640
13:24	11,6	721	14:13	11,8	657
13:26	11,7	546	14:14	11,6	715
13:27	11,6	508	14:14,5	11,5	776
13:36	11,5	507	14:15	11,8	778
13:38	11,5	537	14:16,5	11,8	745
13:40	11,5	647	14:21	11,9	504
13:41	11,7	801	14:21	11,9	504
13:41,5	11,7	801	14:21	11,9	504

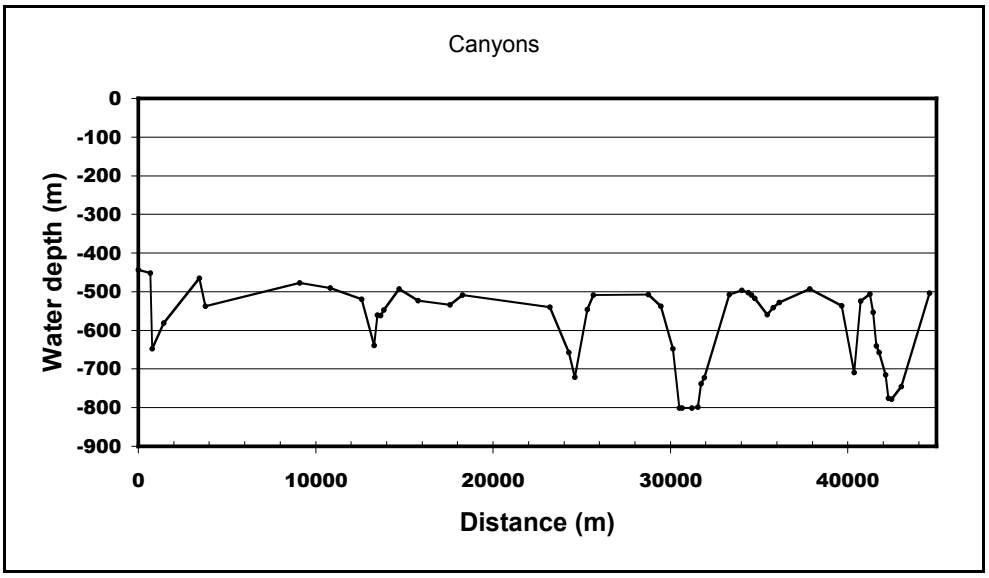

Figure 2: Water depth along cruise path with evidence of canyons on the shelf.

DISCUSSION

From the ship's sounder, submarine depressions that were interpreted as canyons were observed in water depths of 400 m (Fig. 2). The canyons showed bottom depth of up to 400 m deeper than the flanks that stand at 400 m deep. Given that the shelf is very narrow in this region, the canyon heads might be very close to land and deep enough to provide habitat conditions for the coelacanth. The border area between Tanzania and Mozambique lies at the same latitudinal region with the Comoro islands and geographically close to the islands. The regions are thus expected to have similar vertical temperature distribution. In the Comoros the fish is found to rest in caves at depths of 200 m (Fricke *et al*. 1991). Such depths in the study area will be found at the shelf edge where canyon heads are expected. The accidental captures in the region might have involved animals that were out of their hideout on hunting. During the hunting activity the coelacanths are known to move up and down between 180 and 400 m as well as horizontally covering some kilometers of coastline (Fricke and Hissmann, 1994; Hissman *et al*. 2000). As they are not known to venture farther out in the open ocean they are unlikely to cross vast waters between landmasses.

The aforegoing discussion shows that geomorphologically, the region has a potential of providing home to the coelacanth. The captures recorded in southern Tanzania may therefore be considered part of a resident population. The work ahead should be on identifying the landward extent of the canyons and the vertical temperature distributions followed by dives to ascertain presence of caves and overhangs and possibly the fish in its hideout.

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