Assessment of tsunami impact on natural-eco systems of Yala National Park, Sri Lanka and monitoring response of eco-systems

Centre for Conservation and Research

Sri Lanka

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INTRODUCTION

The tsunamis that impacted Sri Lanka on 26th December 2004 represent a catastrophic environmental event that occurs in the region with a periodicity of a few hundred years. The last documented tsunamis in the region were caused by the cataclysmic explosion of Krakatoa in 1883. Given the rarity of the phenomenon and the uniqueness of the impacts caused by tsunamis, such as the massive scale of disruption and inundation by sea water up to a few km inland, studying how a natural system responds to such an event is of great scientific interest. While the effects of the tsunamis would be expected to be largely negative, the changes in landscape could also benefit particular groups of organisms and provide them with evolutionary opportunities. With a periodicity of a few hundred years, it is possible that tsunamis represent a catastrophic environmental event that shapes eco-systems and has evolutionary implications.

As far as we have been able to ascertain, the impacts of tsunamis and the response to them of natural tropical eco-systems has hitherto not been investigated. Being situated in the south-east corner of the island and hence in the direct path of the recent tsunamis, the Yala National Park in Sri Lanka provides a rare opportunity to conduct such an investigation. Therefore, we propose to conduct an initial survey of the tsunami impact on this system and develop a monitoring program that will provide such information.

Expected outputs

At end of initial survey

- A report detailing the impact of the tsunami on a tropical eco-system
- A scientific paper published in an international peer reviewed journal on same
- A scientific paper presented at an international conservation meeting on same
- Recommendations for restoration and recovery (if determined to be needed)

At end of monitoring

- A report detailing the response of a tropical eco-system to tsunami impact
- A scientific paper published in an international peer reviewed journal on same
- A scientific paper presented at an international conservation meeting on same

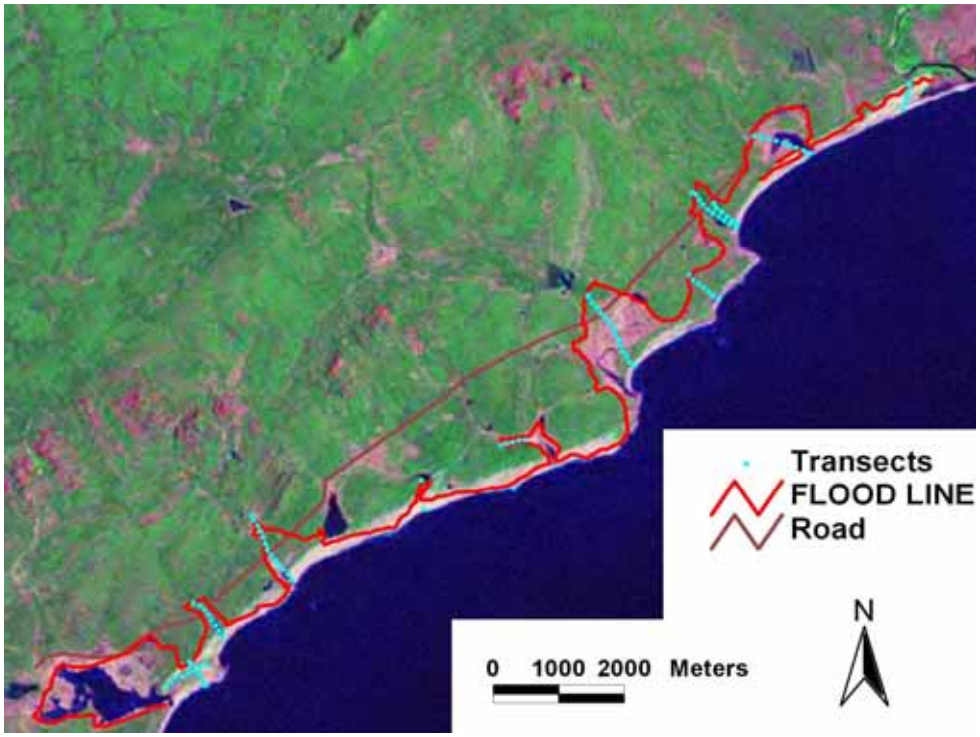
Recommendations for restoration and recovery (if determined to be needed)

METHODOLOGY

Study area: The survey will be conducted in the coastal zone of Yala National Park, extending from Palatupana in Block I through Block II, to Okanda in the Yala East National Park (see map 1).

Map 1. Area surveyed (Block I) marked by green and area to be surveyed (Block II and Yala East) marked by red line.

The monitoring will be conducted in Blocks I and II of Yala National Park. The Yala National Park is situated in the South-east corner of Sri Lanka and bore the direct brunt of the tsunamis. While parts of the coastline were protected by coastal sand dunes, sea incursion on to land has occurred through lagoon inlets, estuaries and areas not protected by dunes (preliminary data for Block I – see map 2)



Map 2. Yala Block I. Area inundated – red line. Blue dotted lines – transects.

Initial survey

The survey will be mainly a descriptive study. It will be conducted over a period of 30 days. The coast line and the area of impact will be surveyed from Palatupana (Yala Block I) to Okanda (Yala East). It will consist of mapping the area of impact and assessment of the effects on vegetation and fauna, with observational data collection on beach line, dune height, extent of flooding, type of damage etc.

Mapping of topographic features

Initial observations suggest that a large extent of the Yala National Park was protected from the impact of the tsunamis by the presence of sand dunes. As the topography of sand dunes often changes, they are not usually mapped and no information on them is available in topographic sheets. The height of the sand dunes will be measured by the use of an inclinometer and a laser range finder. Mapping them will provide us with information on whether they indeed did protect the coast line. This is of practical importance as there is interest in commercial mining coastal sand dunes for minerals (outside the park). If there is a clear co-relation with the presence of sand dunes and protection, such activities may have to be re-assessed.

Preliminary observations suggest that in some areas, the beach was eroded by the tsunami while in others it was built up by massive sand deposition. We will map the beach line by walking the perimeter. The line will be used to ground-truth current imagery and compared with past imagery to assess impacts.

Area inundated

The perimeter of the area inundated will be traversed on foot, and GPS locations recorded every 50 m by the use of a hand-held GPS unit. The perimeter will be identified as indicated by dead grasses, herbs and debris washed up by the wave. The data will be superimposed on geo-referenced satellite imagery using GIS mapping.

Effects on fresh water bodies

Water samples will be collected from fresh water bodies and tested for salinity.

Effects on vegetation

Effects on the vegetation can be divided into three main aspects - effects from the force of the wave, from inundation by salt water, and from sand deposition. We will study these aspects by mainly looking at the impact on three groups of vegetation; grasses and herbs, bushes, and trees.

The damage to trees will depend on their size and distance from the beach. These measures correlate with the strength of the wave when it hit the tree. Since the strength of

the wave could not be measured, tree damage will provide an indirect measure of wave force. Therefore, we will measure the dbh (diameter at breast height) of damaged trees, the type of damage, and enumerate their positions in relation to the distance from the sea. As the wave force diminishes with distance to the sea, we expect the damage to the vegetation from wave force to decrease going inland. Damage will also depend on the structural aspects of different species of flora - for example initial observations suggest minimal damage to palms and very large trees as well as sea shore vegetation. Identifying the species of trees and plants damaged in combination with their measurements will give us information on this aspect. The effects of high salt concentrations are likely to be observed within the entire area inundated. Enumerating the position of such effected vegetation will provide a clear indication of the impact zone.

Line transects will be done in areas inundated in the direction of wave propagation on land, and data collected every 100 m (see attached data forms: Annex I).

Effects on fauna

Effects on fauna will be assessed opportunistically. Any remains of dead animals will be recorded. It is likely that groups such as small mammals, amphibians and land snails have been heavily impacted in the area. However, assessment of initial direct impact on these groups will not be possible; hence we will look at re-colonization by these groups of the areas affected, using adjacent areas as controls. Given the logistic constraints of conducting faunal surveys and especially the use of invasive sampling methods such as trapping within the National Park, we will consider land snails and amphibian as indicator species for terrestrial and fresh water habitats. The faunal survey will be limited to these two species, and observational data will be collected. We will conduct line transects to determine densities of land snails, and perimeter surveys of water bodies to assess amphibian populations. It is also possible that the habitat created by the tangled vegetation from trees and bushes uprooted by the tsunami will also positively benefit groups such as small mammals and birds, providing refugia, nesting sites etc. Anecdotal information on such observations will be collected opportunistically.

Monitoring

Habitat types

We will study two different disturbed habitats, tentatively identified as scrub forest and short grass plains, to be finalized after the initial survey. For each habitat we will choose one to three study areas and make one grid over each study area. For each habitat the grids all together will provide a minimum of 100 center points. Control plots will be established in similar, unaffected habitats.

Vegetation

The effected area will be identified using the result from the initial survey. Study areas will be selected based on representative habitats, area effected and logistic considerations such as access. We will lay a regular 100 m grid over the study area. The size of the grid will be determined in relation to the size of the study area, and adjusted to provide grid points 100 m apart from each other. Based on the coordinates determined on the map we will then mark each grid point in the field. To find the grid point on the ground, we will use GPS instruments. The salt content in the ground will be assessed at each grid point, using an EC-meter.

The recovery of trees will be monitored using the "point-centered quarter method". For each category to be studied, the four trees that are still standing and are closest to the center point will be marked. Those four trees will be situated in the four quadrants associated with the center point. The distance to the center point and the trunk diameter at breast height (130 cm above ground, dbh) will be measured and the tree species identified. For each standing tree we will determine if it still has green leaves or if all the leaves are brown or fallen off. Over time some of the trees might recover (grow new leaves) and some trees might still be losing their leaves and die.

We will mark a plot of 4 m x 4 m to study the recovery of grasses and herbs. In each plot we will make a plant species list. The number of plants for each species will also be recorded for herbs.

Fauna

We will conduct 100 m line transects for land snails within each habitat type. Twenty permanent line transects will be placed within the grids with the use of a random number table and directions determined similarly. Perimeter surveys of fresh water habitats for amphibians will be conducted depending on the availability of such habitats. We will test the feasibility of conducting pellet count surveys to estimate herbivore use of the areas and if feasible, will incorporate that into the monitoring plan. In addition, observational data collection on the presence of fauna will be conducted opportunistically.

TIME LINE

Survey

The survey has already been started and we have completed approximately one third of the area to be surveyed. We hope to complete the survey by mid February.

Schedule of monitoring

The marking of plots will be completed by end February.

At the beginning we will study each disturbed plot every two months, to ensure that we capture the moment when the recovery starts. After one year we will study each plot every six months (February and August each year). The undisturbed plots will be studied every six months right from the beginning. Since the study area experiences a dry (Feb.-Sep.) and wet season (Oct.-Jan.), it is advisable to keep collecting data twice a year over the whole study period. To ensure that the recovery of the trees is also recorded, the study will be conducted over a period of 10 years.

Publications/reports

We have already presented the preliminary survey data to the Department of Wildlife Conservation at a meeting held at the Yala National Park on the 29th January 2005. A full report will be submitted on completion of the survey.

We have submitted an abstract to the 2005 Society for Conservation Biology meeting to be held in Brazil.

On completion of the survey, a detailed manuscript for a peer reviewed journal will be written.

A set of publications, reports etc. will be prepared once the monitoring is completed or sufficient data is collected to examine trends in response.

BUDGET

Line item	**cost**	**Total**
Equipment		
Salinometer	$ 400x1	400.00
Subtotal I		**400.00**
Initial survey	**30 days**	
Transport	40$/dayx 2 vehicles x 30 days	2,400.00
Trackers	5$x2personsx30 days	300.00
Subtotal II		**2,700.00**
Setting up study plots	**15 days (300 grid points)**	
Transport	40$/dayx15 days	600.00
Field assistants	10$x2personsx15 days	300.00
PI	50$/dayx15 days	750.00
Equipment		
plot markers	0.25 $x (300)x4	300.00
Tree tags	0.10$x40x150	600.00
Subtotal III		**2,550.00**
Monitoring (First year)	**15 days/field visit x 6 field visits=90 days**	
Transport	40$/dayx90 days	3,600.00
Supervisor/PI	50$/dayx90 days	4,500.00
Botanist	20$/dayx90 days	1,800.00
Field assistant	10$/dayx90days	900.00
Subtotal IV		**10,800.00**
Misc. 10%		1,645.00
CCR overhead 10%		1,809.50
Total		**19,904.50**

BUDGET JUSTIFICATION

Although the project is expected to go on for a period of ten years, the budget provided is only for the initial survey and the first year of intensive monitoring. Monitoring in subsequent years will be at a low frequency (twice a year), and will be covered by CCR.

Equipment

A salinometer (Electrical Conductivity meter) is required to test soil and water salinity. We hope to obtain some of the other necessary equipment such as GPS units, cameras and range finders, from other sources, and some equipment such as compasses, inclinometers and a few GPS units will be provided from CCR. Therefore, these have not been included in the budget.

Transport

Transport has been costed as $40.00 per day for a 4WD vehicle. Much of the area to be surveyed is very inaccessible and remote, and a team of 10-12 persons will conduct the survey. Therefore, 2 vehicles have been costed for the survey. For setting up plots, and monitoring one vehicle will be used.

Personnel

Trackers from the Department of Wildlife Conservation will be paid $ 5.00 per day (in addition to the salary provided by the DWLC). Field assistants remuneration has been costed at $ 10.00 per day, a botanist at $ 20.00 per day and the PI (JP) as $ 50.00 per day. Co-PIs PF and DW will also be conducting field work, and EW conducting GIS analyses, but their contributions have not been costed for this project. Similarly, the team for the survey will include CCR personnel and volunteers whose contributions have not been costed on this project.

Misc.

Misc. will cover minor costs incurred during field work such as for food, water, photographic film and printing, batteries for GPS and communication equipment, transport to and from the project area etc. and is costed at 10% of the budget.

CCR overhead

CCR overhead is calculated at 10% of the budget and will cover costs of report writing, printing, manuscript preparation etc. and administrative costs.

Annex I

Tsunami Damage Survey Form

GPS F: N 06º_____ E081º_____ Date: _____

B: N 06º_____ E081º_____ Team: _____

L: N 06º_____ E081º_____

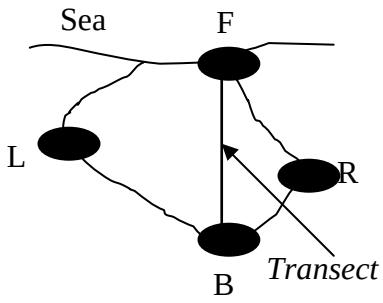
R: N 06º_____ E081º_____

Vegetation Type:

O grass land
O scrub
O scrub and forest
O forest

How did the water come:

O over beach
O breached a sand dune
O through existing outlet



Sketch:

Comments: _____

_____

_____

_____

Annex I

Vegetation Data from Transect

meters from the beach: _____ GPS: N 06º_____ E081º_____

Grass and Herbs (within 10 m)

O all dead, covered by sand
O all dead, brown
O most dead, few still green
O few dead, most still green
O all alive/green
O nothing new growing
O new grass growing
O other new plants growing

Bushes (within 20 m)

O unrooted (might have been transported)
O mostly unrooted (still in place)
O new leaves growing
O standing, no old leaves left
O standing, with old leaves

Trees (on a strip 2x20 m wide and 2x50 m long)

Category	Size Class (cm)	Circumference (cm)	with old leaves	no old leaves	with new leaves
unrooted	16-30				
	30-50				
	50-100				
	>100				
mostly unrooted	16-30				
	30-50				
	50-100				
	>100				
standing	16-30				
	30-50				
	50-100				
	>100				

Measure the closest tree to the transect point for each category. From a standing tree measure 130 cm above ground.