

India in its post-tsunami rehabilitation and reconstruction efforts (UN, 2006). Since environment sustainability is a critical component of the framework, the UNDP launched the 'Post-Tsunami Environment Initiative' (<http://www.ptei-india.org>), a project jointly executed by the Nature Conservation Foundation (NCF), Mysore, the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore and the Citizen, consumer and civic Action Group (CAG), Chennai. This complements other projects in the region by local and international agencies. This project aims to understand coastal vulnerability and resilience in the face of such natural disasters within the Indian context, establish participatory monitoring systems, critically analyse developmental policy, and develop management models for key sites along the coast.

As mentioned, coastal issues have to be viewed in the context of processes that preceded the tsunami. In July 2004, the Ministry of Environment and Forests (MoEF) set up an Expert Committee headed by Professor M.S. Swaminathan to carry out a comprehensive review of the CRZ Notification. Its mission was to enable the MoEF to base its coastal regulations on strong scientific principles and to devise regulations that would meet the urgent need for coastal conservation and development / livelihood needs. The Committee submitted its report in February 2005, a month after the tsunami (MOEF, 2005). Clearly, there are deficiencies with the CRZ and with the overall design and implementation of coastal area

management in the country. While the general principles outlined by the Swaminathan Committee are commendable, the actual planning and implementation of an enhanced management regime go far beyond the report (Sridhar *et al.* 2006).

Sridhar *et al.* (2006) outline the steps that need to be taken in order to implement an improved coastal management regime. Principally, they recommend the need for a clear timeframe for implementation, a state-wise review of the CRZ notification including current violations and loopholes, major public consultations/workshops to facilitate a participatory process for developing changes to legislation, and incorporation of hazard and risk management in the overall coastal management mechanism with adequate flexibility to account for specific cases.

Future research and detailed review based on primary and secondary biological, legal and sociological information is required to guide policy changes, accompanied with monitoring along the coast. Detailed geo-referenced maps need to be prepared for the entire coast to facilitate a GIS-based approach to coastal management. This should be in the public domain and in user-friendly formats along with all other CRZ related information to encourage widespread regulation of the law. Coastal conservation and management, both within and outside the context of the tsunami, needs to take into account a full range of issues if it is to be successful in the long term.

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## Marine turtle status and distribution in the Andaman and Nicobar islands after the 2004 M 9 quake and tsunami

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### Introduction

The pre tsunami status and distribution of the leatherback turtle (*Dermochelys coriacea*), hawksbill turtle (*Eretmochelys imbricata*), green turtle (*Chelonia mydas*) and olive ridley (*Lepidochelys olivacea*) in the Andaman and Nicobar islands has been documented over the last two decades (see Bhaskar, 1979, 1993; Sivasundar & Devi Prasad, 1996), Andrews (2000), Andrews & Shanker, 2002 and Andrews *et al.* (2006). Bhaskar (1993) and Andrews *et al.* (2006) have also discussed the historical records of marine turtles in these islands. Bhaskar & Andrews (1993) formulated an action plan for the four species in the islands.

The leatherback and hawksbill populations nesting in the Andamans and Nicobars are the largest for India and most important for the Northern Indian Ocean region. The leatherback nesting population in the Nicobar islands was one of the few colonies that exceeds over 1000 nesting individuals in the Indo-Pacific, and hence of global significance (Andrews & Shanker, 2002). Andrews & Tripathy (2004) and Andrews *et al.* (2006) recorded 30 nesting sites in North Andamans, 27 in Middle Andamans, 21 in South Andamans, six sites in Little Andaman Island and 26 sites in the Nicobar group.

The 26<sup>th</sup> December 2004 M 9 quake caused the subsidence of the Nicobar Islands and areas around South Andaman Island, besides an upheaval, by an average of 1 m, on Little Andaman Island, northwestern South Andaman, entire Middle and North Andaman Islands including Landfall Island. The subsidence of the

Nicobars and South Andaman Island by an average of 1 m caused high tides reaching inland and flooding of coastal lowlands. In the Nicobars, being just north of Sumatra, coastal habitats in all the 23 islands have been affected, and beaches and coastal habitats have been swept away. The impacts and ecological changes in both island groups have been discussed in detail by Andrews (2005), Sankaran (2005), Andrews & Vaughan (2005) and by Jayaraj & Andrews (2005).

### Methods

Observations and assessments of the coastal habitats and beaches, and reef flats were conducted by ground surveys. Areas and islands were assessed with a local inboard, dugout canoe (Andaman dungi). Reef flats were observed onshore and offshore. In Great Nicobar Island, surveys were conducted by ground and helicopter surveys and in central Nicobars by boat and on foot. Some areas of South Andaman Island were surveyed over land. Beaches were surveyed on foot during the mornings and evenings to count turtle nests and tracks; tracks/crawls were categorized as fresh, (crawls with visible flipper marks), and old (those with either only the nest excavation mound and or faint tracks visible). The data recorded were counts made on a single walk (on occasion to and fro) along a beach to ascertain the presence or absence of turtle nesting activity, and species visiting the beach. Off shore sightings were also recorded and surveys were conducted during January-April 2005 and during January-March 2006. Two field camps were started during the second week of October 2005, for monitoring nesting, at Cuthbert Bay, north east of Middle Andaman Islands and at Rutland Island, on Jahaji beach, on the southern side of the island.

## Results

### *Middle and North Andaman Islands*

During January–April 2005 and January– March 2006, the beaches on South Reef, Interview, North Reef, Snark, Point, Paget, Reef, West, Landfall and East islands were surveyed (Fig: 1). There was very little changes to the beaches on these islands but due to the upheaval of reef flats, many nesting beach areas have become inaccessible for turtles. The reef flats on the northern, western and the southern sides of South Reef Island, extend for roughly about 2 km<sup>2</sup>. Six nests of hawksbills were recorded during the 2005 survey on this island. The beaches on the south west coast and north eastern side of Interview Island have become inaccessible for turtles to nest due to reef flat upheaval. The beach on the south west coast of Interview Island used to be one of the most favoured nesting beaches for green turtles (Bhaskar, 1984; Andrews *et al.*, 2001). The sea grass bed on the north of Interview Island at Brasse Point had been swept away; however regeneration of small tufts, 3-4 cm high, was observed. Over 10 green turtles and three hawksbills of different size classes were sighted in this bay (Andrews & Vaughan, 2005).

Beaches on North Reef Island, on the north western and eastern sides, have minimal changes; however the beach on the south eastern side has built up. Due to exposed reefs to an extent of 4.5 km<sup>2</sup>, marine turtles do not have access to these beaches for nesting and this was evident as no tracks or nests were found on these beaches. Two plastrons of green turtles were found on the west coast and no evidence was available to conclude the cause of death. However, 22 sightings of green turtles around the island, off shore and among deeper reefs, were recorded (Andrews, 2005). During the 2006 survey, a few under nourished green turtles were seen trapped in tide pools and lagoons created due to reef upheaval. The reef flats on the western, southern and eastern side of Latouche Island were also exposed and eight green turtles and three hawksbills were sighted off North reef Island.

The exposed reef flats along the northeastern side, the northern, eastern and the southern sides of West Island, is estimated to be 4.5 km<sup>2</sup>. Reefs, 2- 4 m deep, were observed on the eastern and southern sides of Snark and six green turtle nests and nine tracks and four hawksbill nests were found on Snark Island. Beaches on the southern sides of Snark Island have changed very little. Due to the upheaval of reef flats, turtles do not have access to the beaches on the eastern and western sides of Point, Paget, West, Landfall and East Islands (Fig. 1). On Flat Island, no signs of nesting were observed during the 2005 season; however during the 2006 survey, two green turtle nests and one hawksbill nest were recorded. Opposite Flat Island on the main island of Middle Andaman, a beach and spit cover the coast where rocky shoal and coral reef abut the passage between Flat Island and the main island. A single hawksbill nest was recorded on this beach in 2006.

Very minor changes have occurred to beaches along the western and eastern coasts of Middle Andaman Island (Fig. 2). Most beaches were swept away only partially and high tides reached the forest though subsequently in 2006 new beach deposits were observed. These beaches include, from the south western side, Foul Bay, Tanmuguta, Yadita and Robert Bay; and on the eastern coast, Cape Vestal, Paikat Bay, Woteng and Cuthbert Bay Turtle Sanctuary. Green turtles and olive ridleys were nesting up to April 2005 at Paikat Bay, Woteng and at Cuthbert Bay.

ANET monitored turtle nesting trends during early January 2005 at Cuthbert Bay Turtle Sanctuary. After the tsunami, six green turtles were encountered and two nested. Of the 94 olive ridleys encountered, 65 nested and the one leatherback encountered also nested. Nesting on this beach ceased by 27<sup>th</sup> April 2005. During the following nesting season, October 2005 to March 2006, 118 olive ridleys were encountered and 109 nested, 16 green turtles were encountered of which eight nested and two leatherbacks were encountered, but did not nest.

### *Ritchie's Archipelago and South Andamans*

During March 2005, eight green turtle and three olive ridley nests were counted on Middle Button Island. Eleven green turtle and six olive ridley nests were observed on Inglis/East Island. During the 2006

survey, 21 green turtles and 3 leatherbacks were found to have nested on North Button Island. Along the South Andamans, the Madhuban Beach east of South Andaman, along Mount Harriet National Park, north of Port Blair, was surveyed during 2005 (Fig. 3). Old and fresh tracks and nests of two species of turtles, green turtles and three olive ridleys, were recorded. However, these nests could not have survived as they were being flooded during high tides.

During the 2005 survey, it was observed that the beaches on east and west Twin islands, Rutland, North and South Cinque and South Brother Islands were partially swept away and the high tide reached the forest line. The sand bar along the south western side of North Cinque was swept away by the tsunami and currently a sand bar has formed and the beach has built up. Very minor impacts on coastal forests were observed on all these islands, including Boat, Hobday, Redskin and Tarmugli Islands. There was no evidence of nesting on these islands after the tsunami in 2005.

During the last monitoring programme by ANET, between October 2005 and March 2006, the team on Rutland Island encountered 44 green turtles, of which 22 nested, and 19 olive ridleys, of which 17 nested; of the 10 hawksbills encountered, three nested and of the 12 leatherbacks that emerged on the beach, 10 nested. During November 2005, one leatherback and two green turtle nests were recorded on North Cinque Island and there was no evidence of nesting on South Cinque. During the same month, three hawksbill nests and one green turtle nest were observed on east Twin Island and nine hawksbills and four green turtle nests on west Twin Island. A second survey of the same islands conducted during March 2006 resulted in six green turtle, three hawksbill and one olive ridley nest on east Twin Island, and three green turtle, six hawksbill and four olive ridley nests on west Twin Island.

#### *Little Andaman Island*

The three major sea turtle nesting beaches surveyed during March 2005, West Bay, South Bay on the west coast and Butler Bay on the

eastern coast, were all affected. These beaches were washed away partially and submerged during the high tide. There was no evidence of turtle nesting on these beaches in 2005, but observations and indications during the 2006 survey suggest significant visitation and nesting by turtles, especially leatherbacks and that these beaches are reforming. Two other large beaches were formed after the tsunami, one starting at the northern side off the mouth of Jackson Creek measuring a length of 5 km (Fig. 4). Turtle tracks and nests of three species, green turtles (four nests), olive ridleys (three nests) and leatherback (two nests), were recorded from this beach. Another 2 km long beach had formed, situated 4 km south of Jackson Creek and four nests of green turtles and two olive ridley nests were found on this beach.

During the 2006 survey, an older member of the Onge community remarked that they (the Onge from Dugong creek) had gone turtle hunting along the shore and off the mouth of Dugong Creek, after many of their women told them that they wanted to eat turtle meat. The men went out along the shore and to sea returning with a few green turtles and the women were disappointed as the turtles were lean and did not have any fat and meat. They then realized that the sea grass beds were damaged and the sea turtles did not have much to eat. The women then told the men that despite their hunger to taste sea turtles, it would be better to wait and allow the sea grass to grow so that sea turtles could feed themselves before they became food for the Onge; since then they have not hunted.

#### *Great Nicobar and areas in the central Nicobar group of islands*

The Nicobar Islands were surveyed during January – February 2005. The entire coastal area and habitats have been completely affected and destroyed impacting all coastal flora and fauna and affecting some of the mega species. In the Galathea area and the entire South Bay, the tsunami wave had gone inland to a distance of almost 1.5 km. This had destroyed all the beaches, mangroves and the entire coastal habitat of South Bay, including the areas around the light house at 51 km. Debris, consist of fallen trees, plastics, timber and other flotsam from the sea drift on to the land at each high tide. The high tide line reached the hill slope upto the forests; existing coastal trees, mangrove species and other

coastal flora are drying up. During the month of April 2006, it was reported that the coasts along western Great Nicobar Island had regressed further due to continued wave action and erosion (R. Sankaran *pers. comm*). The same effect was observed on the west coast of Little Nicobar Island and islands in the central group and on Car Nicobar Island.

The most affected sea turtle nesting beaches along the east coast of Great Nicobar are the Galathea beach and the beach stretch from 47-51 km (along the north – south road), and along the west coast are areas near the Alexandria and Dagmar Rivers, Rekoret and Renhong. Beaches along Little Nicobar west coast and Katchal Islands and those areas on Great Nicobar Island were prime sea turtle nesting beaches and these have been washed away. In Great Nicobar Island in South Bay, two beaches are forming, one at 43 km and at the other at 45.5 km (along the north – south road). Hawksbills and olive ridleys were observed nesting at these two beaches. However these nests were destroyed as these beaches flood at high tide. Beach deposition had taken place toward the end of 2005 from Indira Point, the southern most tip of Great Nicobar Island, to Inhingloi on the west coast. The beaches on the west coast and North eastern coast of Little Nicobar Islands were impacted; however leatherback nesting was observed up to March 2005 along the west coast at Muhincohn beach (M. Chandi, *pers. comm.*).

### Recommendations

Currently no major management or conservation effort, apart from continuing sea turtle monitoring and awareness programs, is required for the Andaman and Nicobar Islands. The sea turtle beaches that have been affected will reform after a few monsoons and other new beaches will form in the next two to three years; this will require monitoring as marine turtles will find new nesting beaches. However, the next five years will be crucial and intensive surveys and monitoring will be required to quantify nesting trends, populations and the nesting beaches forming along the islands.

Coastal planting and restoration programmes are currently not required and mangroves and *Casuarina* plantations may not protect from tsunamis. There is also no need for creating wind breakers, as there are other native littoral species (other than *Casuarina*) that can be used to reduce erosion along coast. Natural regeneration and succession of species of flora are underway that could be affected by undue human intervention. In the absence of adequate information on natural resilience and succession, human interference should be minimised. There is also an urgent need for surveys of sea grass beds to quantify impacts and extent. The growth and regeneration of sea grass beds have implications for sea turtles that rely on them for food. Further, a GIS based analysis is required to derive the actual extent of beach and reef flat loss, besides remapping the entire Andaman and Nicobar Islands and its topography.

There is an urgent need to review fisheries practices around the islands and fishing zones. Fishing should be restricted to only 5 km offshore from the high tide line of all islands. During the past several years, surveys by ANET have observed and recorded drowning and entanglement in gill nets and drifting ghost nets, leading to death of sea turtles in significant numbers. Awareness generation and enforcement of no fishing zones in vulnerable regions are required. A plan of action needs to be urgently formulated and immediately implemented for removal of feral and domestic dogs from the Andaman and the Nicobar Islands, as they predate on eggs of turtles and also on nesting turtles.

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Figure: 1. North Andaman Islands

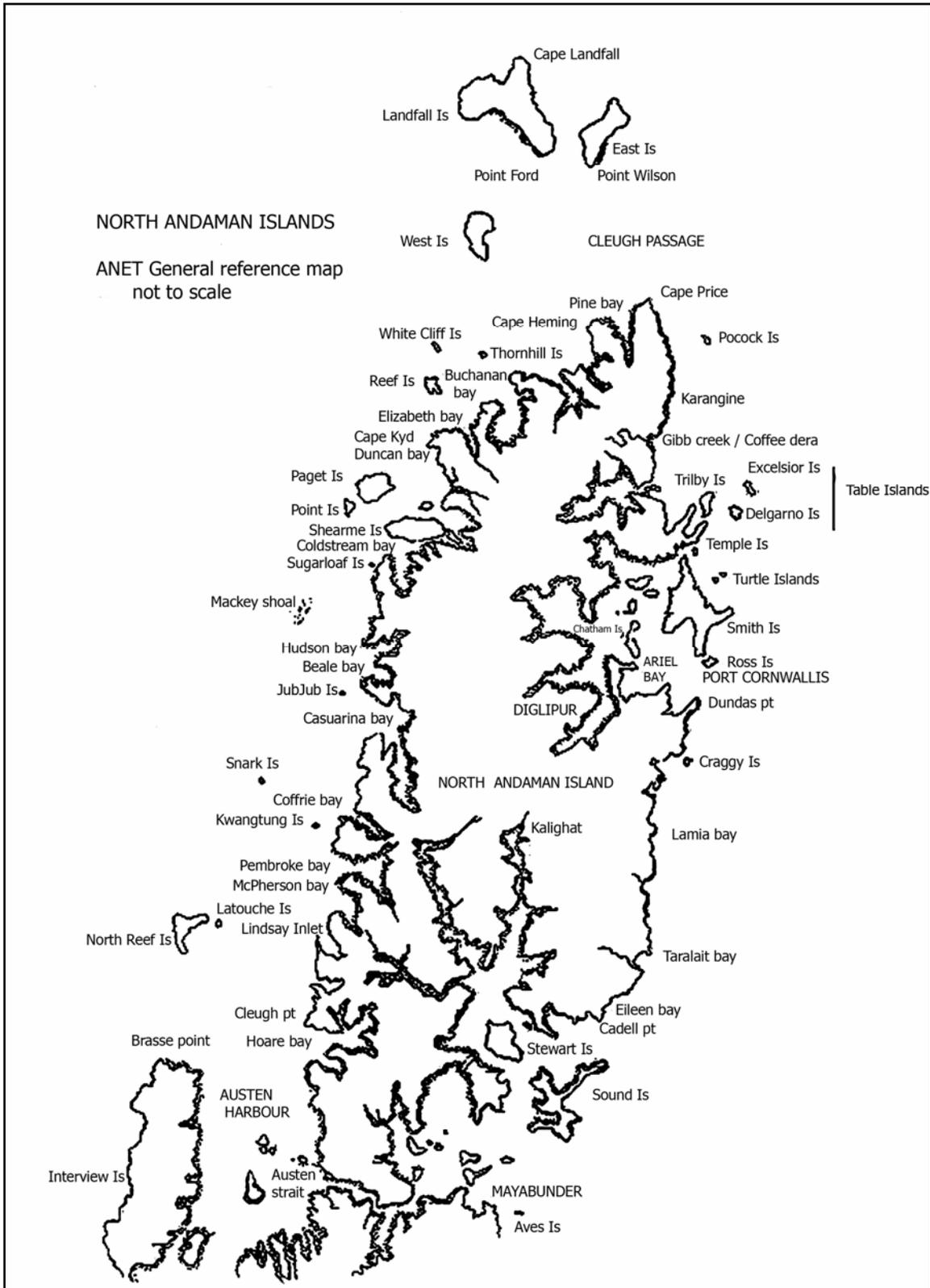


Figure: 2. Middle Andaman Islands

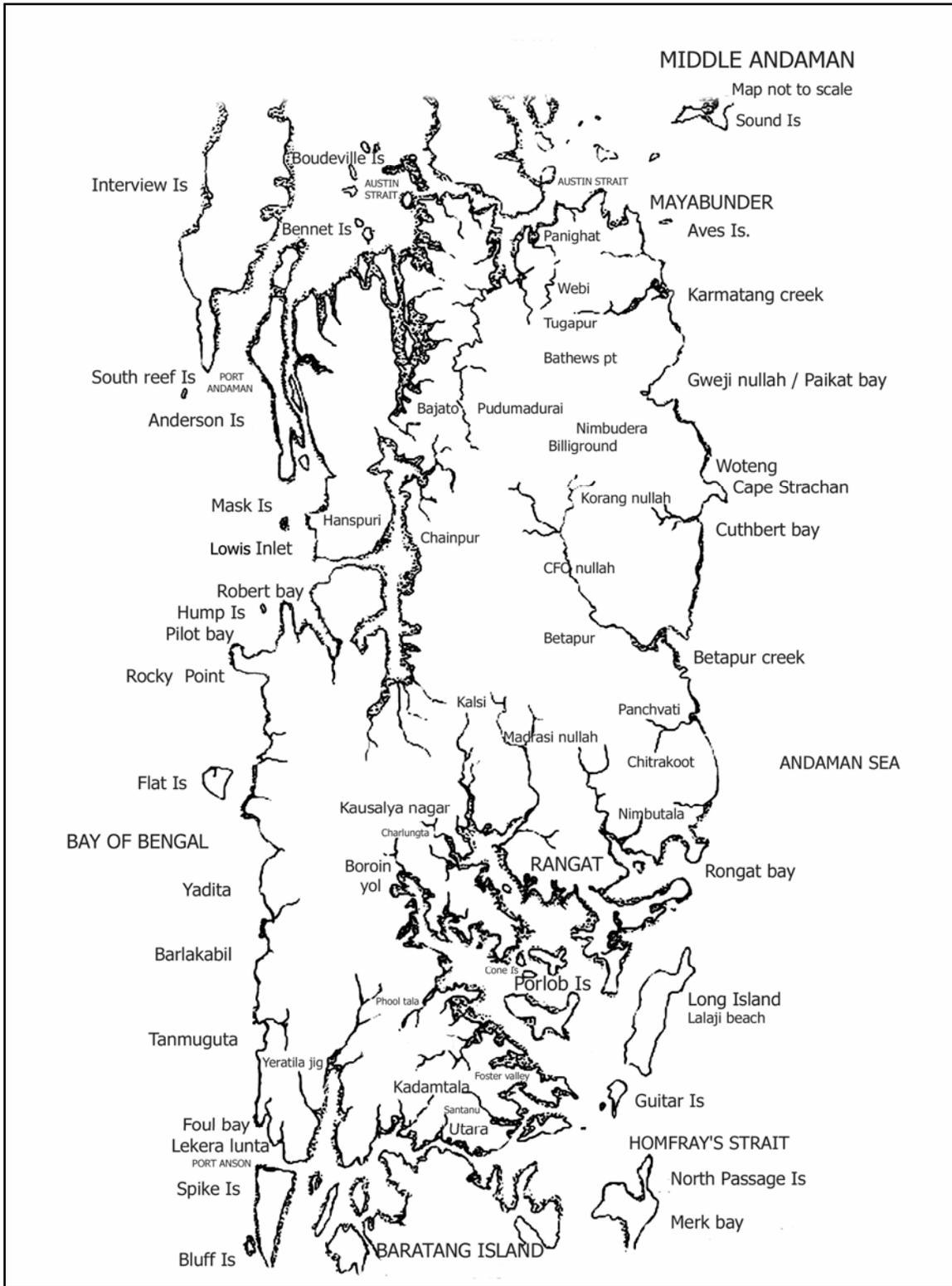


Figure: 3. South Andaman Islands and Ritchie's Archipelago

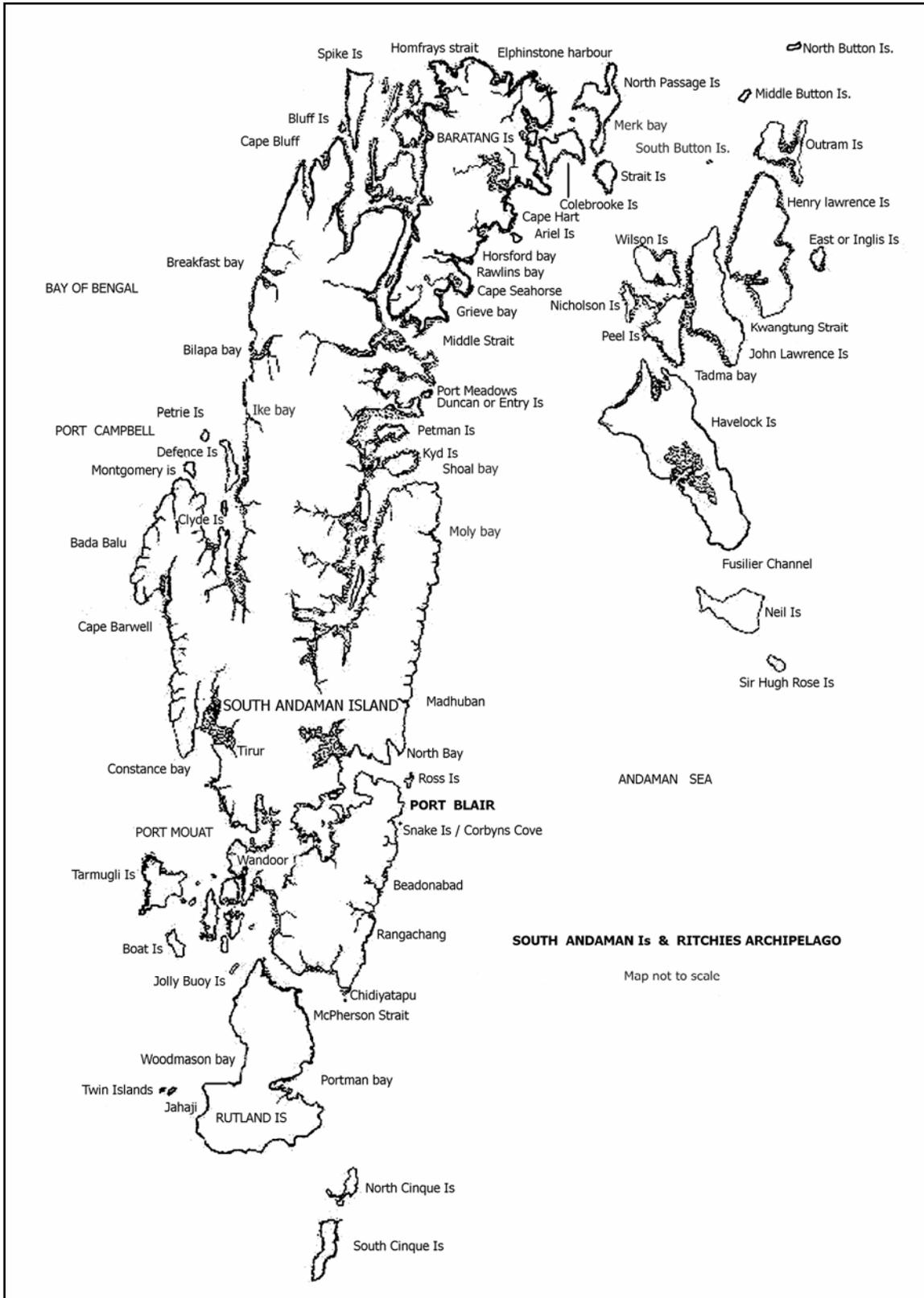


Figure: 4. Little Andaman Island

