

THE IMPACT OF COASTAL DEVELOPMENT ON TURTLE NESTING
IN THE VICINITY OF PAKA/KERTEH, TERENGGANU
WITH RECOMMENDATIONS FOR MANAGEMENT OF THE
TURTLE POPULATIONS

A Report to the
Turtles Sanctuary Advisory Council of Terengganu

By

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1.

BACKGROUND AND METHODS

The east coast of Terengganu in the vicinity of Kerteh and Paka is undergoing rapid industrialization. This stretch of coastline also provides important breeding habitat for three species of sea turtle--the Green Turtle (Chelonia mydas), the Olive Ridley (Lepidochelys olivacea) and the Leatherback Turtle (Dermochelys coriacea)--and also for the "Tuntung Laut" or Painted Terrapin (Callagur borneoensis).

During the 1991 nesting season we studied the distribution of turtle nesting along the coastline in the Paka/Kerteh area in order to assess the impact of existing and proposed coastal development on the turtle resources. Our study area included the entire 13.2 km of nesting beach extending from Ma' Daerah (just north of Kerteh) to the mouth of the Paka River, but focused on the four tendered areas where turtle nesting is highest--Ma' Daerah, Cakar Hutan, Rhu Kudung and Tanjung Batu. Figure 1 shows a map of the study area.

We recorded the distribution of turtle nesting emergences in the study area to see how it relates to the industrial facilities now operating--i.e. the Petronas refinery and the Paka power station, and also to the 2.4 km stretch of undeveloped coastline between these two facilities which also has been zoned for industry.

Once every three days we surveyed the nesting beach in each of the tendered areas and recorded the following information about each turtle track encountered:

- 1) Its exact position along length of the beach platform;
- 2) The species of turtle; and
- 3) In what activity the turtle engaged while up on the beach platform. In particular we evaluated whether or not she constructed any nests, and if so, whether egg deposition occurred.

The distribution of nesting emergences was then correlated with the following factors associated with coastal development that are known to be harmful to nesting turtles:

- 1) Artificial light visible on the nesting beach at night (the intensity of which was measured with a lux meter and the light meter of a camera); and
- 2) Physical disruption of the beach platform including removal of vegetation, sand mining and bull-dozing.

2. RESULTS OF THE STUDY

2.1 Impact of Artificial Light.

Figure 2 shows the amount of artificial light visible on the beaches at night. Within the Ma' Daerah, Cakar Hutan, Tanjung Batu and Rhu Kudung tendered sites, the distribution of turtle nesting emergences was inversely proportional to the intensity of the artificial light visible on the beach at night--i.e. most nesting occurred on the darkest parts of the beach. (Compare Figure 2 with Figures 3 and 4.) This relationship was especially clear for Green Turtles but less so for Olive Ridleys and Leatherback turtles.

Nesting density was low near the brightly lit Petronas refinery at Tanjung Batu beach, near the Paka power station at Rhu Kudung beach, and along the northern half of Cakar Hutan beach where light from the gas flares was visible at night. At Ma' Daerah where no artificial light was visible at night, nesting emergences were evenly distributed along the length of the beach.

2.2 Impact of Physical Disruption of the Beach Platform

Along one section of beach 1400-1650 meters north of the Tg. Batu rocks a pipeline had recently been laid. Vegetation had been removed from the beach platform, the sand surface had been bull-dozed and sand mining had occurred. Although turtles did emerge onto this stretch of beach, no successful nestings were recorded. Likewise, the low density of nesting emergences that occurred along the northern half of the Cakar Hutan beach also coincided with a section of the beach platform that had been disrupted by removal of beach vegetation and by sand mining.

At both sites, removal of beach vegetation would have lowered the horizon behind the beach, thus causing the beach to appear "less dark" to a nesting turtle. Moreover, we found evidence that

Green Turtles chose densely shaded areas of the beach platform for their nest sites in preference to unshaded stretches of open sand.

3. RECOMMENDATIONS

In view of the relatively high density of turtle nesting that occurs along the 2.4 km coastline that has been zoned for industry, we recommend that efforts be made to minimize the impact that any proposed facility will have on the nesting turtles. We also recommend that the Petronas refinery and the Paka power station now in operation take action to reduce the impact that their facilities now have on the turtle populations. The following issues need to be addressed:

3.1 Artificial Light Visible from the Beach and the Sea

Artificial light visible at a turtle rookery is known to disorient hatchling turtles making their way from the beach out to sea, and also to discourage breeding female turtles from coming ashore.

At both the Petronas refinery and the Paka power station too much artificial light is now visible on the nesting beach. At both sites, most of the offending light is produced by security lights shining directly onto the nesting beach.

We strongly recommend that the following guidelines be used to modify the facilities at the existing Petronas refinery and Paka power station. We also recommend that any new facilities be designed according to these guidelines.

- 1) Insofar as possible, all external lighting should be shaded so that it is not visible either from the nesting beach or from the sea.
- 2) In those cases where it is absolutely essential to place artificial lights where they are visible from the beach or from the sea, these lights should be low-pressure sodium vapor (LPS) luminaires.

LPS luminaires emit only yellow light. Studies testing the impact of various types of luminaires have shown LPS luminaires to be the least disruptive to both hatchling turtles (Witherington and Bjorndal, 1991) and to nesting females (Witherington, in press).

Important Note: High-pressure sodium vapor light (HPS) emits a much broader spectrum of wavelengths and is not appropriate for a turtle nesting beach.

- 3) The above recommendations regarding artificial illumination of the project site apply to both permanent lighting fixtures and also to temporary lighting set up during construction of the facility.

If low-pressure sodium vapor (LPS) luminaires are not available in Malaysia, they can be obtained from the following company:

V. L. Service Lighting Corporation
5780 Midnight Pass Road, 603B
Sarasota, Florida 34242 U.S.A.

3.2 Destruction of Beach Vegetation

In any future development that takes place along the nesting beach, we recommend that at least 10 meters of beach vegetation be retained intact behind the beach. Not only will this measure protect the breeding habitat of the turtles, it will also protect the property adjacent to the facility from erosion--especially that caused by wind.

We recommend that during any future construction, barriers be erected around this vegetated zone to make it off limits to construction personnel and machinery.

3.3 Gazettement of a Turtle Nesting Sanctuary in the Paka Area

We strongly recommend that in light of the importance of the turtle populations now nesting at the site of the proposed joint venture, a turtle nesting sanctuary should be established in the Paka area. Cakar Hutan beach had originally been suggested for this site, but we have since concluded that Ma' Daerah beach would be a far more suitable turtle sanctuary for the reasons listed below.

- 1) Because Ma' Daerah beach is located farther from the site of a proposed breakwater, it is less likely to suffer erosion caused by that structure.

- 2) Forested hills are located behind the entire stretch of Ma' Daerah beach. These will effectively shield the beach from the impact of artificial light and noise coming from developments inland.
- 3) The forested slopes of the hills are full of wildlife including monkeys and hornbills (both of which we saw during every visit we made to the beach). During 1990 a tiger was seen at Ma' Daerah beach. The forest adjacent to Ma' Daerah is one of the few tracts of coastal forest remaining in the area.
- 4) The beach vegetation adjacent to Ma' Daerah is still in its natural state thus comprising a rare example of an undisturbed beach ecosystem.

3.4 Recommendations for Management of the Sanctuary

- 1) We strongly recommend that no development be allowed on either Ma' Daerah beach or on the forested slopes visible from the beach.
- 2) Ideally, the sanctuary would include both Ma' Daerah and Cakar Hutan beach. But, if this is impossible, we strongly recommend that development only be allowed at Cakar Hutan, preferably with minimal disruption of the shoreline.
- 3) Preservation of the beach vegetation. Presently the beach vegetation at Ma' Daerah is in a completely natural state. It should be preserved as such.
- 4) The beach vegetation has been disturbed at the north end of Cakar Hutan beach. We recommend that natural beach vegetation should be replanted in that area according to the following suggestions:
 - a) Casuarina (Casuarina equisetifolia) should not be planted immediately adjacent to the sand beach for the following reasons:
 - i) Toxins produced by this species inhibit growth of all other vegetation. Turtles prefer to nest in shrubby undergrowth. Moreover, shrubby undergrowth will shield the nesting beach from the impact of

artificial light from inland sources. The widely spaced trunks of casuarina offer no such barrier to light.

- ii) Turtle nesting is inhibited by the dense roots of casuarina.

For these reasons we recommend that casuarina be planted at a minimum distance of 15 meters behind the beach.

- b) Among those species of plants that occur naturally on the beach and are very compatible with nesting turtles are the following:

- i) Shrubs and trees:

Scaevola taccada
Guettarda speciosa
Tournefortia argentea
Pandanus odoratissimus
Terminalia catappa
Calophyllum inophyllum
Premna corymbosa
Heritiera littoralis

- ii) Vines and creepers:

Ipomea pes-caprae
Spinifex littoreus
Vitex trifolia

Instructions for planting some of these species are given in Yap and Adnan (1991).

3.5 Protection of All Turtle Eggs Laid

Because turtle eggs in the Paka area, as elsewhere in Terengganu (Mortimer, 1989) have been over-harvested for so many years, all eggs laid should be allowed to incubate. A legal ban needs to be imposed on the harvest and sale of turtle eggs for human consumption.

4.

CONCLUSIONS

We conclude that efforts to conserve the populations of turtles nesting in the Paka area must focus on minimizing the impact of facilities presently in place along with those planned for the future, on designating land as nesting sanctuary for the turtles, and also on increasing protection for the eggs that are laid. Gazettement of the beach and the seaward slopes of the forested hills at Ma' Daerah would provide sanctuary to nesting turtles as well as to flora and fauna that are representative of the lowland forest community. Moreover the hills behind the beach will effectively screen Ma' Daerah beach from the impact of artificial light and noise produced by inland industrial facilities.

Although Cakar Hutan was originally suggested as the site for a nesting sanctuary, we believe that Ma' Daerah is preferable for the following reasons:

- 1) The lack of hills behind Cakar Hutan will make it vulnerable to the impact of artificial light coming from the industrial facilities.
- 2) The proximity of Cakar Hutan to the site of a proposed breakwater may have an adverse effect on its beach profile.
- 3) The beach vegetation behind Cakar Hutan has already been disturbed and the sand mined; while Ma' Daerah provides a rare example of an undisturbed beach ecosystem.

If a hotel is built behind Cakar Hutan beach, we believe that the Ma' Daerah turtle nesting sanctuary would be an excellent tourist attraction for visitors staying at that hotel. Formal guided tours could be organized to show the tourists nesting turtles.

The guidelines regarding artificial lighting (see section 3.1) would pertain to any facilities constructed at Cakar Hutan.

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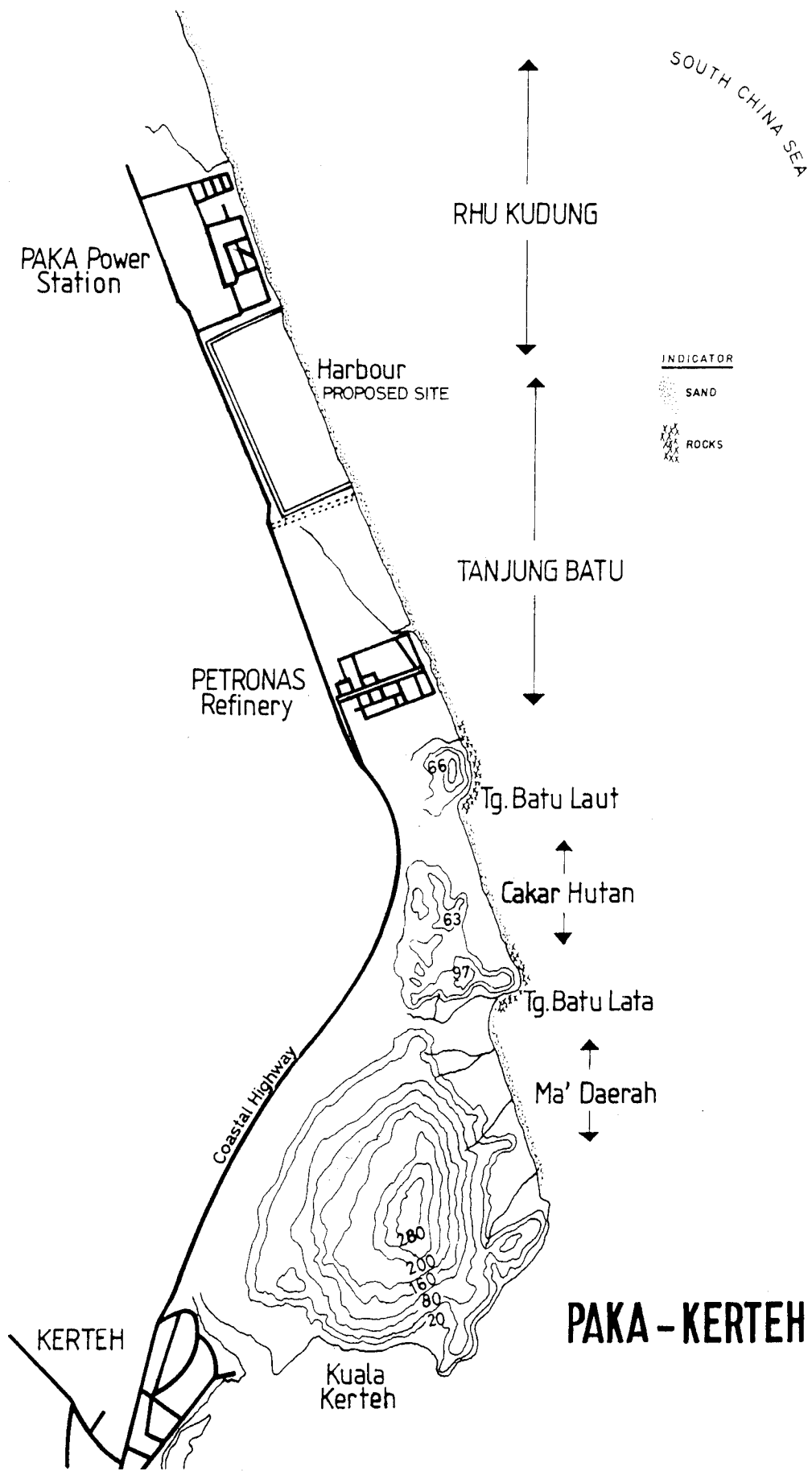
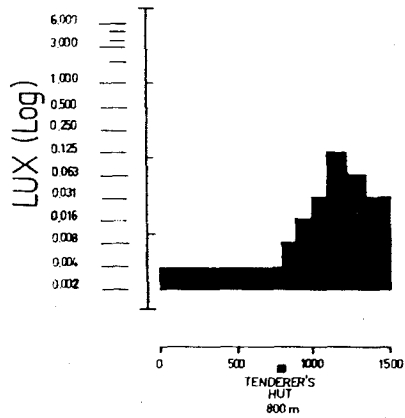
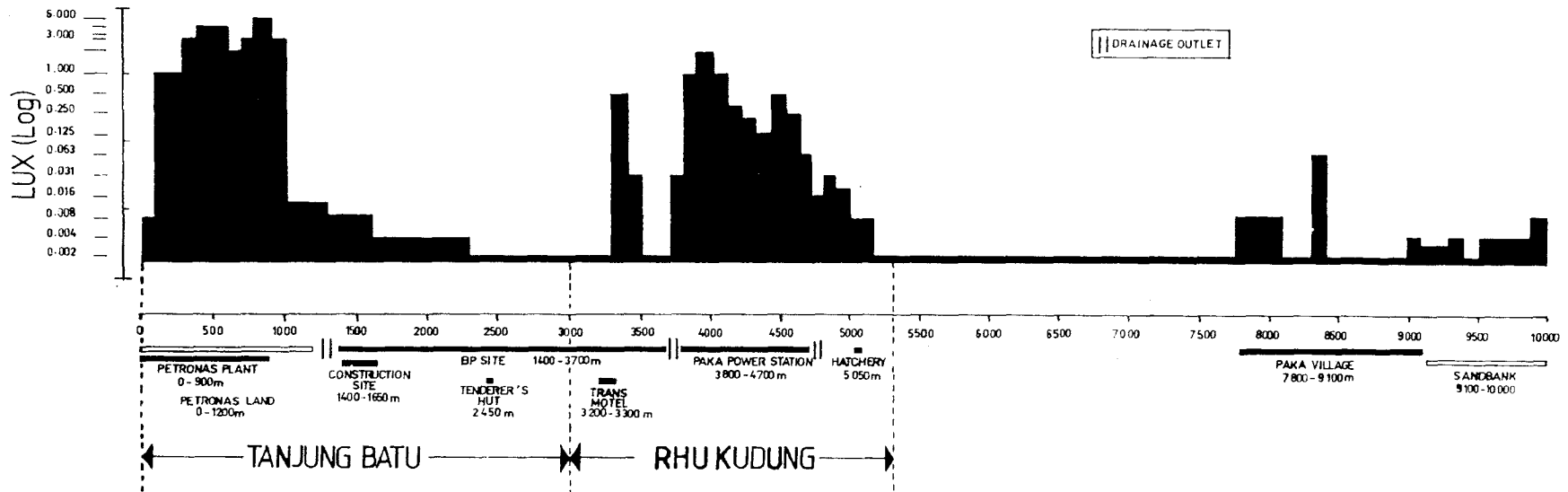
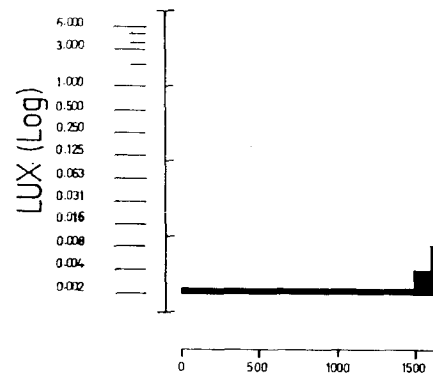


FIGURE 1. Contour map showing the shoreline and the topography in the vicinity of the study site that includes Rhu Kudung, Tanjung Batu, Cakar Hutan and Ma' Daerah tendered sites.



CAKAR HUTAN



MA' DAERAH

FIGURE 2. Intensity of artificial light visible at night on the nesting beaches in the vicinity of Paka. Light measurements were taken at 100 meter intervals along the entire length of the 13.2 km of nesting beach, and are presented here on a logarithmic scale.

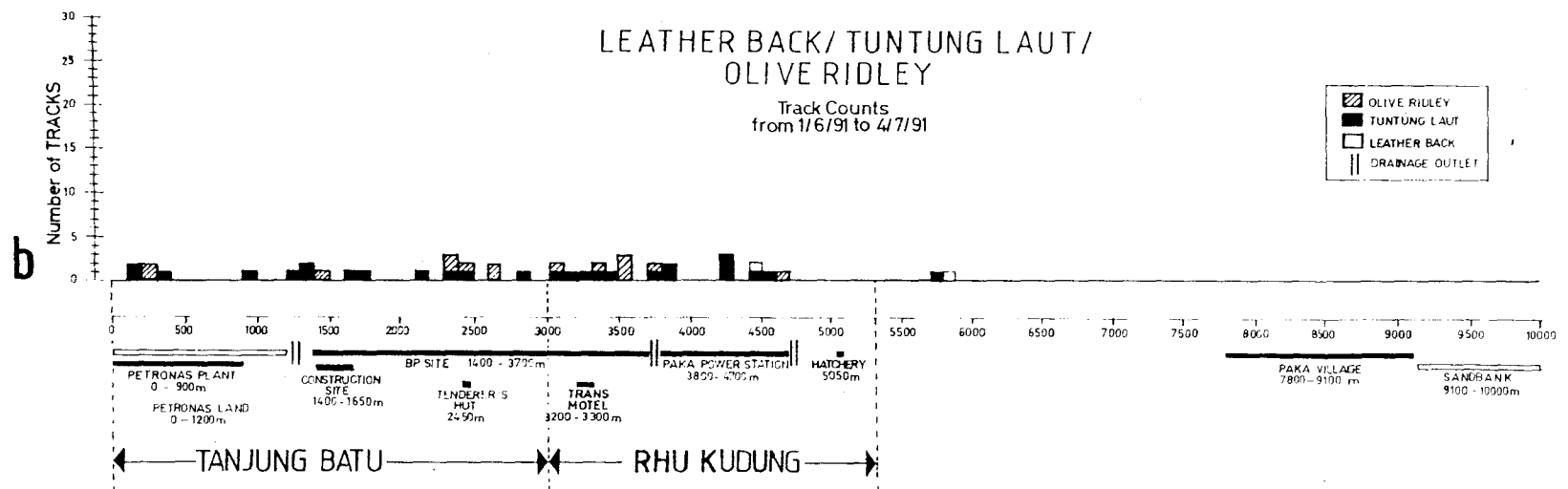
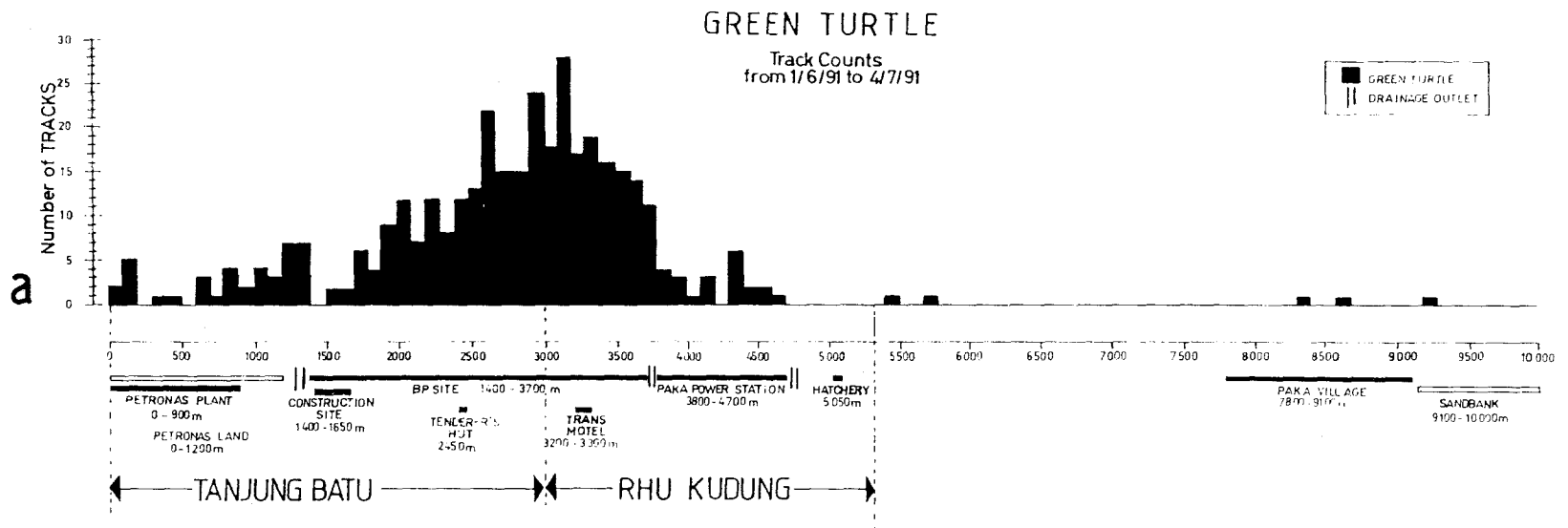


FIGURE 3. All Green Turtle tracks (a) and Olive Ridley, Leatherback and Tuntung Laut tracks (b) recorded during surveys conducted at three day intervals between 1 June and 4 July 1991 along the nesting beach between Tg. Batu and the mouth of the Sungei Paka.

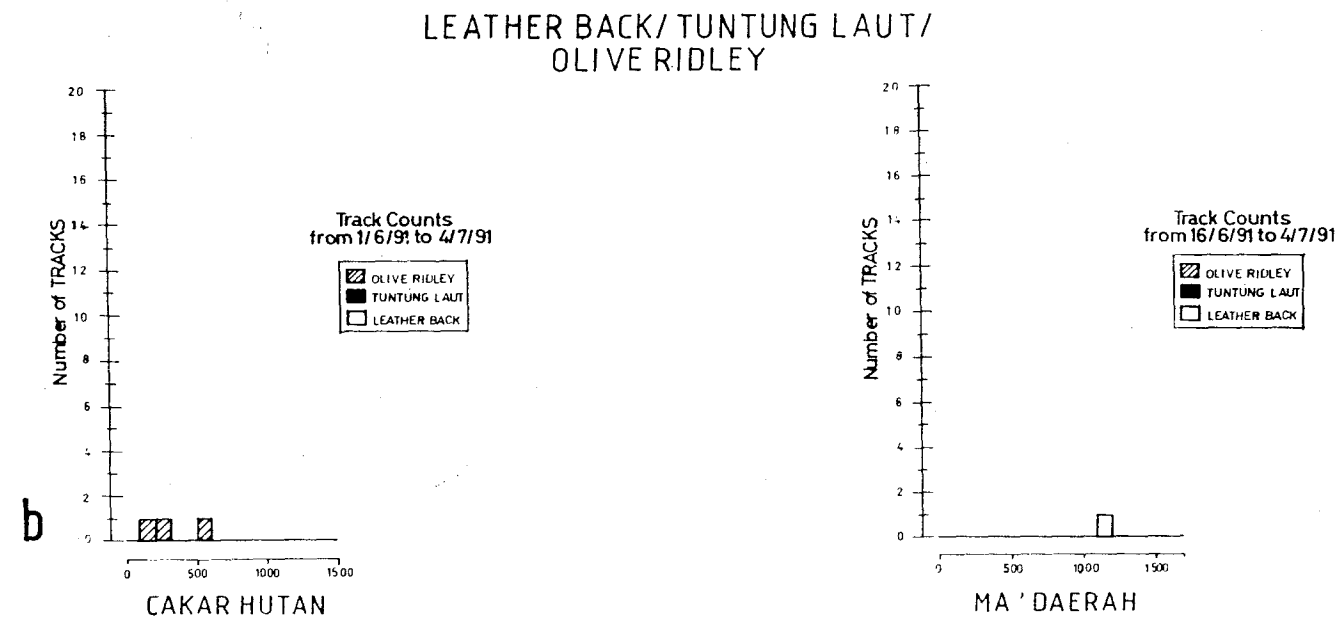
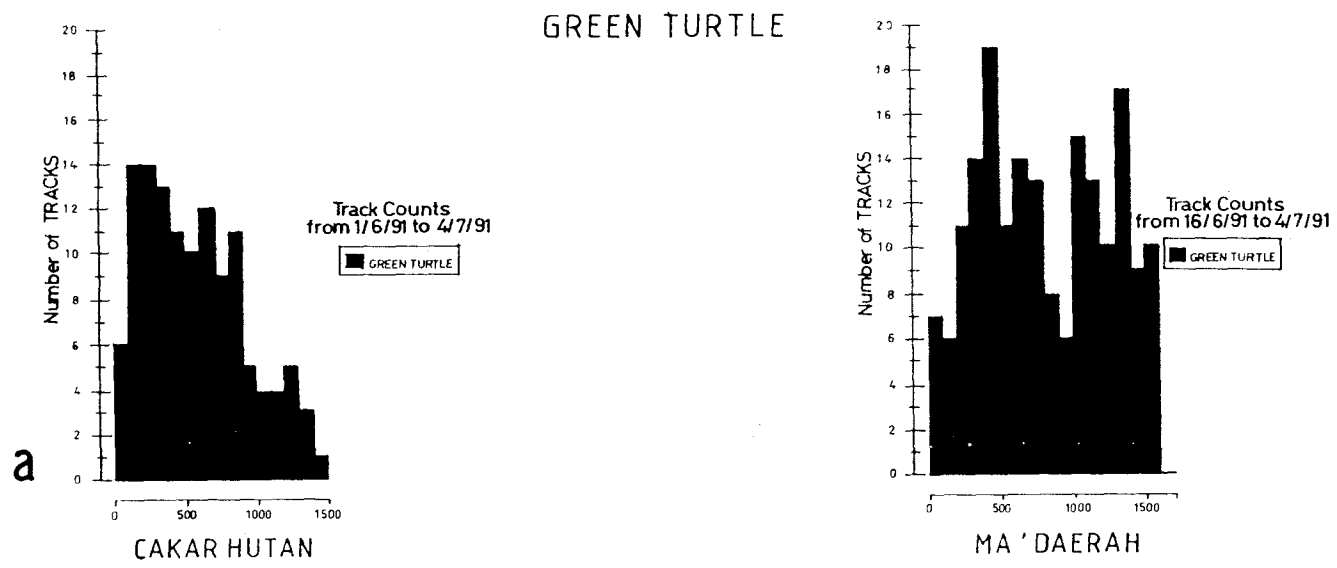


FIGURE 4. All Green Turtle tracks (a) and Olive Ridley, Leatherback and Tuntung Laut tracks (b) visible during surveys conducted at three day intervals at Cakar Hutun beach between 1 June and 4 July and at Ma' Daerah beach between 13 June and 4 July 1991.