In a Single Generation: A Lament for the Forests and Seas of Indonesia

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In a single generation, the vast, majestic dipterocarp forests of lowland Sumatra and Borneo have been cleared. The regionally synchronized mass-flowering of these gigantic trees was an extraordinary feature of the lowland tropical rain forests of Indonesia. The rate at which the loss of these dipterocarp has occurred has been staggering. Land clearance has been carried out for pulp and paper production, for oil palm plantations, for log export and sawn timber, for supposed timber forest plantations, and, most incredibly, to establish a million hectare of irrigated rice in central Kalimantan. On present evidence, forest clearing that was proceeding at a rate of over 1.6 million hectare per year has now risen to nearly 2.4 million hectare per year. At this rate, most of the lowland forests of Sumatra will have disappeared by 2005 and those of Kalimantan by 2010.[1]

In a single generation, the deletion of marine resources has followed a similar trajectory, although the evidence for this depletion and for deep-sea damage to seabed habitats is less immediately discernible. Large-scale BLL (bottom long line) fishing vessels have heavily fished Indonesia's seas in a relentless progression from the Straits of Malaka to the ends of the Arafura Sea. Since 1980, large numbers of sophisticated industrial trawling vessels, many of them foreign ships from Taiwan, Korea and Thailand, have operated virtually without regulatory supervision in the seas of eastern Indonesia. Included in this trawling industry are special prawn trawlers that fish nearer

[1] According to official figures, since 1967 Indonesia's forest concession system has generated 612 m3 of roundwood. This production has resulted in the loss of 100 million hectares of forest. There are a variety of sources for estimates of forest loss in Indonesia. One source is a report for the World Bank prepared by myself, Grahame Applegate and Merrilyn Wasson (2000); another source is a paper by the late Derek Holmes which is about to be published; and the third source is the excellent, recent publication by Carol J. Pierce Colfer and Ida Aju Pradnja Resosudarmo (eds*), Which Way Forward?: People, Forests and Policymaking* (2001). The single best book of its kind on the forests of Borneo is *In Place of the Forest* (1995) by Harold Brookfield, Lesley Potter and Yvonne Byron.

to the shoreline and significantly affect local inshore fisheries. In addition there has developed a substantial live-fish export industry that depends on local reef fishing with potassium cyanide. Indonesia's coral reefs, which are the largest and most extensive in the world, are not only subjected to this destructive over-fishing, but to bombing, mining, dredging, and substantial waste discharge. Almost 94% of all coral reefs have suffered damage. Logging, steep-slope farming with subsequent erosion, agricultural run-off and other widespread pollution have degraded many coastal habitats and with them, the once extensive meadows of sheltering seagrass.

In a single generation, the rich, remarkable species diversity of Indonesia has also come under severe threat. The larger mammals – Sumatran tiger, the Javan rhinoceros and the Asian elephant – that once symbolized the exotic dimension of this diversity have been reduced to numbers that are now more easily enumerated than estimated. The numbers of orang-utan and the dugong are still estimated but these estimates are in the thousands.[2] On a larger scale, Indonesia has the highest number of threatened forest bird species in Asia. Some 101 species are threatened with extinction throughout the country, with the largest number in Sumatra where 17 forest bird species are globally threatened and another 73 are considered in the 'near threatened' category.[3] Indonesia's most commonly targeted fish – snappers and groupers – are all slow-breeding, long-lived species that appear to be heading rapidly toward population collapse.

A single generation has seen the establishment of a national array of marine and forest reserves and parks – but within this same generation, there has been a significant threat to, and the outright destruction of, many of these sanctuaries. Thus two-thirds – some 60,000 out of 90,000 hectares – of the Gunung Palung National Park in West Kalimantan have been destroyed over the past ten years. The Gunung Leuser National Park in northern Sumatra, the Kutai National Park in East Kalimantan (originally

[2] Just as existence of orang-utan can be see as a prime indicator of the quality of a forest, so too with the dugong whose presence is dependent on the quality of coastal waters and their seasgrasses. See Helene Marsh (Compiler), for the report on Indonesia in *Dugong, Status Reports and Action Plans for Countries and Territories.* UNEP.

designated for preservation on a larger scale by the Sultan of Kutai in a previous generation) and Tanjung Putih National Park in Central Kalimantan – to name just three among many reserves – have all suffered serious degradation and continue to be open to extensive illegal logging.[4] The wondrous coral reefs of the marine protected area of Take Bone Rate – potentially Indonesia's greatest marine treasury – are under continuing threat and have already borne the brunt of heavy human spoilage.[5]

A single generation has also seen an assault on particular ecological niches supporting a panoply of targeted products. This has been especially true of the peat-soils that form an essential component of Indonesia's tropical rainforest mosaic. A decade ago Sumatra and Kalimantan had an estimated 15 million hectare of these soils. In some areas, as in the interior of Kalimantan, the accumulated matrix of amorphous organic material that forms these high dome peats began to form over 13,000 years ago; whereas the peat soils of the freshwater swamps of the coastal lowlands are of more recent, shallower accumulation and thus more vulnerable. It is these peat soils that have been the main target for clearing and burning for local agriculture and the establishment of plantations.[6]

The Grand-Gambut Project (Satu Juta Hectare Proyek Lahan Gambut: PLG) that set about to clear 1 million hectare of deep peat forest in Central Kalimantan to establish a transmigration scheme for intensive rice cultivation was doubtlessly the single-most ill-conceived development project of the Suharto era. The scheme has now ended in dismal failure, the construction that occurred during the project has left a large network of primary and secondary irrigation channels, built largely on fibric peat domes, that have exposed an extensive area of peat to dessication and future fire. It has

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[3] Press Release, Birdlife International, Den Haag, 15 April 2002.

[4] *The Final Cut* prepared by the Environmental Investigation Agency and Telapak Indonesia provides a graphic report on illegal logging with particular attention to Tanjung Putih National Park and Gunung Leuser National Park.

[5] Taka Bone Rate is the site of a major effort under Coremap to diminish coral reef. A recent article, "Dynamite, Cyanide Destroy Coral Reefs in S. Sulawesi" by Hasanuddin Hamid in the Jakarta Post, 30 April 2002 provides an indication of the extent of continuing, ongoing damage to these reefs.

[6] See J.O. Rieley and S.E. Page (eds): *Biodiversity and Sustainability of Tropical Peatlands* and in particular, the paper in volume by Rieley, Page, Limin and Winarti, "The Peatland Resource of Indonesia and the Kalimantan Peat Swamp Forest Research Project".

also opened large tracts of land with rich *ramin* and *meranti* forest to unchecked illegal logging. Even the Forest Laboratory for the Study of Tropical Peat Swamps is being systematically robbed of its timber. The decision to end this scheme but extend the development of the Kapuas, Kahayan and Barito catchment and to allow the clearing of peat soils less than three metres has only increased the assault on this vulnerable niche. Transforming this niche could well alter the hydrology of South Kalimantan.[7]

This generation has also seen a recurrence of floods and drought in an oscillating ENS0 cycle. The El Niño droughts of 1982-83 and 1997-98 with their accompanying fires were particularly sharp punctuation points in this period. The fires of 1997-98 are estimated to have damaged 9,745,000 hectares of land throughout Indonesia. 85% of this damage occurred in Sumatra and Kalimantan. During the period of these fires, Indonesia produced more than 750 million metric tons of carbon dioxide – 22% of the world's carbon dioxide production. Indonesia suddenly became one of the world's largest polluters of carbon dioxide, only slightly below that of the United States. An estimated 75% of the 750 million metric tons of carbon dioxide produced in these fires came from the combustion of peat.[8]

This generation has also seen the introduction of new timber replacement species on a level unprecedented in the natural history of the region. Dipterocarp are both slow-growing trees and their processes of regeneration are sensitive to a variety of climatic and other factors. Other 'exotic' species have therefore been introduced as rapid-growing replacements. One species of tree in particular, *Acacia mangium* has become the primary plantation tree of choice but other Acacia and Eucalypts (*A. auriculiformis*; *E. deglupta* and *E. urophylla*) have also been promoted. Out of nearly 6 million hectares allocated for timber plantations, approximately 2.4 million hectare

[7] See Rieley, J.O. "Death of the Mega Rice Project! Creation of Another Monster?" (1999) and for more recent research, Unna Chokkalingam, Luca Tacconi and Yayat Ruchiyat, "Fire Use, Peatland Transformation and Local Livelihoods: A Case of Positive Reinforcement" (2001).

[8] See the paper by Grahame Applegate, James J. Fox, R. Smith, A. Mitchell, D. Packham, N. Tapper, and G. Baines, 'Forest Fires in Indonesia' (2001) which summarizes a final report for the ADB of the Planning for Fire Prevention and Drought Management Project, 1999.

have supposedly been planted with new harvestable timber species, such as *Acacia mangium*.

When Suharto's New Order was being established in the mid-1960s, Indonesia had a population just over a 100 million. Sumatra had over 16 million inhabitants and Kalimantan over 4 million.[9] By 2000, Indonesia's population had doubled to over 200 million but the populations of Sumatra and Kalimantan had more than doubled. Sumatra's population was over 42.5 million and Kalimantan's almost 11 million. This population growth was not just the result of natural increase. It was also the result of a sustained effort to shift people from the densely populated islands of Java and Bali to the outer islands, particularly Sumatra and Kalimantan.

The effects of this policy on the environment are almost incalculable. Official transmigration targeted young rural families who, after they had moved to their new destinations, had larger families than they would have had if they had remained on Java or Bali. To settle these migrants, a large number of forested areas were targeted for wholesale clearing. Once this land was denuded of its valuable timber, soils often proved unsuitable for the agricultural schemes proposed to support the new migrants or flooding posed insurmountable problems for normal farming. This frequently led to a further displacement and a search for other forms of employment. Unemployed men could be diverted to logging on timber concessions (HPH) and families could follow logging trails into the interior to engage in short-term opportunistic cultivation in the wake of forest clearance. In places, this contributed to conflicts between local inhabitants and new migrants in livelihood strategies. Instead of population growth, a range of demographic factors associated with population instabilities fueled rapid ecological transformation.

A single generation is not a long time in historical terms. Virtually all of the changes in Indonesia's environment that occurred during the life of this generation have had a

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[9] Nugroho, *Indonesia: Facts and Figures*. 1967; *Almanak Indonesia*, 1968.

critical human component. It is appropriate therefore to set the transformation effected by a single generation in relation to the time-scale needed to comprehend the magnitude of these transformations.

Two observations are pertinent to this comparison. The first of these relates to peat soils of Indonesia and the second to the dipterocarps as a particular family of trees.

In the case of Indonesia's peat soils, it is possible to calculate the rate of accrual of these resources at different periods over the 10,000 years. Thus high peat accumulated at an average rate of 50 cm per 100 years between 9,600 and 8,440 BP. This rate then slowed from 24 cm to 14 cm per hundred years from 8000 to 5000 BP. Similarly, the accrual of coastal and basin peats occurred at a rate of 20 cm per 100 years between 4500 and 3500 BP years and thereafter slowed to 17 cm per 100 years. In the estimation of present researchers:

> "…subsequent rates of accumulation have been much slower in all peat types and there may be little, if any, peat accumulation in Indonesia at the present day. The reasons for this may be that rainfall intensity and periodicity have changed considerably in the region over recent millennia. This is especially marked in Kalimantan where the annual dry season is now 3-5 months duration, leading to a net water deficit during this period and loss of peat through oxidation and degradation, the rate of which has been estimated to be 10 cm per 100 years." (Rieley et al 1997).

If the accumulation of peat has ceased and indeed gone into reverse, then the massive destruction of these soils through a combination of clearing and burning represents the loss of an irreplaceable and certainly non-renewable resource. The transformation of these specific peatland niches in a single generation represents an irreversible environmental change.

A somewhat similar observation can be made in relation to the great variety of dipterocarp species in Indonesia. A remarkable feature of most of these species is the irregular, yet synchronized, regional timing of their flowering. An individual tree may produce four million flowers from which 120,000 fruits may be set. The fact that this mass-flowering and mast-fruiting can occur, with unexplained suddenness over a wide area, appears to be caused by a drop in minimum night temperature of 2 degrees centigrade or more for a succession of three or more nights. Conditions of this kind appear to be associated with the onset of El Niño-induced droughts.[10]

The existence of a specific seasonal floral trigger among a tree species now widely distributed throughout an aseasonal tropical zone suggests that these dipterocarp may have originated in a region (or at a time) with more notable seasonal variations and by slow penetration in step with the rhythms of the ENSO cycle, gradually established their dominance in the Indonesian region. The time scale for such an establishment process is a matter of millenia. Paleoclimatic studies suggest that temperature conditions for forest growth were greatest from 17,000 to 9,000 BP and that seasonality declined from 9000 Bp to 6000 BP; with greater climate variability associated with the ENSO phenomenon developing during the last five millenia. By contrast, the human plantation of *Acacia mangium* to replace dipterocarp species over hundreds of thousands of hectare, have been carried out over less than two decades and have introduced an entirely different growth-rhythm to the forested environment of Indonesia. These new species will radically alter the fire regimes of Indonesia's forests.

Focus on Two Historical Cases

In a single generation, the impact on the human communities dependent on marine and forest resources has been equally profound. These communities, however, have proven to be remarkably adaptive and it is therefore pointless simply to describe what once was and will never be again. Instead I would like to examine the historical

[10] See Ashton, P.S., T. J. Givnish, and S. Appanah, 'Staggered Flowering in the Dipterocarpaceae' (1988).

development of specific communities whose livelihood has been closely associated with particular resources. An historical perspective provides a better understanding of the quickening pace of recent developments, the intersection of the national and international policies that have shaped the local use of resources, the adaptability of local populations and, despite this adaptability, the resulting dilemma that this poses for such marginalized populations.

The Bajau Quest for Trepang, Turtle and Shark in the Timor and Arafura Seas[11]

No other single marine product has contributed more to shaping maritime relations in the Timor and Arafura Seas than trepang. Trepang, a variety of edible holothurians that have the appearance of a fleshy cucumber, has long been regarded among the Chinese as a kind of `sea ginseng'. This invertebrate sea slug has been in great demand as a potent delicacy and, as sources along the south China coast became depleted, the search for new sources shifted to what the Chinese called Nan-hai, the `Southern Seas'. In the late seventeenth century, the fishing and sailing populations of Sulawesi became actively involved in trepang-gathering and this prompted the search for high quality trepang throughout eastern Indonesia and beyond. Most of the trade in trepang was centred on Macassar in South Sulawesi and, as a result, the trepang industry has been given a `Macassan' label. The fact is, however, that various different Sulawesi populations participated in trepang gathering. Besides the Macassar populations, the most prominent populations involved in trepang gathering were the Sama Bajau.

The southward movement of the Bajau was closely associated with the search for marine products. On the basis of comparative linguistic evidence, Pallesen argues that in the eleventh century, a sea-oriented group of Samal-speakers began to work its way down the Sulu Archipelago. This group became the Indonesian Bajau: "The forward wave of this IB [Indonesian Bajau] movement was to reach the coastlines of the

[11] See Fox 2000 for a longer discussion of this quest for trepang and the historical and regional context within which it has occurred.

Macassar Straits sometime before the European era, probably by way of the east coast of Borneo via Tawau and Tarakan" (1985:121). This account locates the Bajau in southern Sulawesi toward the end of the fifteenth or the beginning of the sixteenth century. Generally these populations lived in dependent relations with the more powerful sailing peoples such as the Macassarese, Bugis or Butonese, supplying them with produce from the sea.[12]

As a highly mobile sea population, the Bajau were involved in the search for new sources of trepang. By the eighteenth century, they had begun to explore the coastal waters of the Timor Sea. Dutch records from the early eighteenth century document the initial movement of the Bajau into the area. In a letter of the 9th of May 1725 from the chief Dutch Company officer in Kupang to the Governor-General in Batavia, there is a report of the apprehension of "seven Bajau or Macassarese fishing vessels with 91 of their people" at Bernusa near the island of Alor. These boats were said to have come from `Papuk' in the Gulf of Bone[13]. A few years later, in another letter to the Governor-General of the 14th of May 1728, the chief officer in Kupang reported:

"Forty small Bajau Laut boats which appeared here mostly in the domain of Thie [on the southwestern coast of Roti] some of whose people came ashore under the pretext that they had come to look for trepang; since the Rotinese rulers did not, however, trust the people, they refused them their shores and made them depart from there, whereupon the boats also appeared on the 8th of March in the open sea outside of this fortress…" (Fox 1977a: 460).

By the 1750's, the gathering of trepang in the outer arc of the Lesser Sundas became regularized. `Macassan' vessels began to arrive in the Timor area with formal letters

[12] In addition to Pallesen's linguistic study of the Sama-Bajau (1985), a useful, broadly based study of these remarkable people is Clifford Sather's The Bajau Laut (1997).

[13] Already at this period, the Bajau were identified as `Macassarese'. This is a form of identification that continued to be used for them well into the nineteenth century, especially because of their close involvement in the Macassan trepang trade. `Papuk' provides a further identification that is consistent with an origin of these Bajau from Sulawesi. According to Pelras, `Papu' was the hereditary title of the "`sovereign of the Sama' whose seat, if one can employ that expression in speaking of someone who dwells at sea, was at the base of the Gulf of Bone, in the Luwu region" (1972:164-165).

of permission from the Company allowing them to gather trepang without hindrance (VOC *Timor Boek* for 1759, K.A. 2857). The search for trepang, however, extended beyond the Indonesian archipelago to the shores of northern Australia.

Writing about his experiences in northern Australia at the beginning of the nineteenth century, Matthew Flinders points to the link between the gathering of trepang on the Ashmore Reef – directly to the south of the island of Roti – and the discovery of much larger resources of trepang on the Australian coast:

"The natives of Macassar have been long accustomed to fish for trepang...upon a dry shoal lying to the south of Rottee; but about twenty years ago, one of their prows was driven by the northwest monsoon to the coast of New Holland, and finding the trepang to be abundant, they afterwards returned; and have continued to fish there since that time" (Flinders 1814, II: 257).

Throughout much of the nineteenth century, Bajau regularly visited Australia on their own and in Bugis vessels to gather trepang.[14] This 'Macassan' trepang gathering has been well documented by Campbell Macknight in his excellent study *The Voyage to Marege': Macassan trepangers in northern Australia.* George Winsor Earl, in his *Sailing Directions,* made an extraordinary estimate of this trepang industry:

"The trade in trepang, or sea-slug, which gives employment to 80-100 of the Bughi prahus, on the north coast of Australia alone, and the entire produce of which is taken to China, far exceeds in value the fur-trade, carried on between the N.W. coast of America and China" (1839:14).

[14] Earl, who had a great admiration for the Bajau, reports a Bajau vessel at Port Essington in 1840 and describes this boat as "belonging to that singular people the Badju, a tribe without fixed home, living constantly on board their prahus, numbers of which congregate among the small islands near the southern coast of Celebes" (Earl 1846:65). Five years earlier, in 1835, Earl had planned to go on a trepang-gathering expedition with Bajau, setting out from Macassar and going, via the Aru islands, to the north coast of Australia.

In the 19th century, the Bajau were also crucial in the gathering of trepang in the Aru region of the Arafura Sea. Trade in this commodity was centred on Makassar. Alfred Russel Wallace has vividly described this 19th century trade in *The Malay Archipelago*. In his description of Makassar as "one of the great emporiums of the native trade of the Archipelago", Wallace remarks on the great variety of natural products, including trepang from the Gulf of Carpentaria, available in local Bugis and Chinese stalls. He then goes on to note the even greater abundance of marine products from the Aru islands:

"More important than all of these however is the trade to Aru, a group of islands situated on the south-west coast of New Guinea, and of which almost the whole produce comes to Makassar in native vessels. These islands are out of the track of all European trade... Pearls, mother-of-pearl, and tortoiseshell, find their way to Europe, while edible birds' nests and `tripang' or sea-slug are obtained by shiploads for the gastronomic enjoyment of the Chinese"(1869, II:158).

By the end of the 19th century, this abundant trade had begun to diminish and continued to do so through the 20th century. More significant than this diminishment in marine resources in the Arafura Sea, the establishment in 1891, of the KPM (*Koninklijke Paketvaart Maatschappij:* The Royal Packetnavigation Company) gradually achieved its stated aim of reducing "the profitability of prahu shipping to the point where new prahus would no longer be built, and the fleet would gradually diminish by attrition" (Dick 1987:107; see Fox 2000). In 1893, Australian authorities began imposing licensing fees and duties on Macassan vessels of all sizes. The last official voyages to northern Australia came to an end in 1906-7 (McKnight 1976:110-114).

Trepang can reproduce asexually under certain tidal conditions but they normally reproduce sexually. Because they are relatively sedentary, proximity within a reasonably sized breeding community is critical to local replenishment. The repeated

harvesting of specific stocks limits the cycle of replenishment and can endanger local survival of stocks.

Trepang come in a great variety and their culinary qualities have decidedly different market value. High quality trepang have commonplace English names that give no idea of their taste attractions. Black Teatfish (*Holothuria nobilis*), White Teatfish (*H. fuscogilva*) or even Prickly Redfish (*Thelenota ananas*) are far more sought after than medium value Lollyfish (*H. atra*) or low value Elephant Trunkfish (*H. fuscopunctata*). It is these high market value trepang that are being harvested at an unsustainable level. And as a consequence, the quest for trepang throughout most of the Timor and Arafura Seas has become ever more problematic.

The Arafura Sea is the only region of Indonesia where trawling vessels are still licensed and thus able to carry out continuing damage to near shore reefs and seabeds with impunity. The whole of the region is clouded in a fog of illegal, unlicensed, unregulated and unreported fishing that jeopardizes not just the livelihood of the mobile Bajau fishers but that of virtually all the local coastal fishing communities.[15] And the Bajau themselves face competition from other mobile fishing groups such as the Sinjae Bugis who have invested in diving equipment to gather trepang at greater depths and Butonese, many of whom come from the Tukang Besi Islands.

The response among some Bajau communities has been a shift to shark fishing or more specifically, sharkfin fishing, to provide another high value culinary delicacy for the Chinese market. One such community that made this shift was the Bajau settlement of Mola on the island of Wanci in the Tukang Besi Islands. In the 1980s, this village was still reported to be engaged in trepang gathering but by the late 1980s and early 1990s, in response to the diminishing supply of trepang and the increasing price of sharkfin, fishers from this village (and other nearby Bajau villages) began to concentrate on shark fishing.

[15] Brian Fegan has written a number of invaluable reports (1999, 2000a, 2000b,2001) on fishing in the region which provide the clearest information on the extraordinary overfishing in the Timor and Arafura Seas.

Ashmore Reef and the Australian Memorandum of Understanding

In 1974, the Australian government concluded a Memorandum of Understanding with Indonesia that identified five small points on the northwest Australian continental shelf to which traditional Indonesian fishermen were given access. These areas are 1) Ashmore Reef, 2) Cartier Islet, 3) Scott Reef, 4) Seringapatam Reef and 5) Browse Islet. The Memorandum allowed fishing around these areas to include the taking of trepang, trochus, abalone, green snail, sponges and all molluscs on the seabed adjacent to these areas, but not turtles of any species.[16]

Although the definition of 'traditional' fishermen was ambiguous and resulted in a further advisory clarification in 1988, the Memorandum has been taken to include fishers from the island of Rote as well as Bajau whose regular fishing voyages to the Ashmore Reef area in the 20th century can be documented.[17]

Ashmore Reef is the largest and most important of the five tiny areas designated in the Memorandum. It is a raised platform reef near the edge of the Sahul Shelf approximately 120 kilometers directly south of the island of Rote. In 1983, the Australian government declared Ashmore Reef a National Nature Reserve because it is a staging point for migratory birds, a breeding ground for dugong and several varieties of turtles and because of its unusual biodiversity. The Government Website on Ashmore reports that it "has the highest known diversity and density of sea snakes in the world". This declaration banned the removal of all fauna and flora to a depth of 50m.

[16] It permitted landings to obtain fresh water at two points on Ashmore Reef and allowed boats to shelter within the group without landing except at Ashmore. This Memorandum, which is a simple document of three pages plus a map, provided a basis for traditional Indonesian fishing in Australian waters. It came into effect on 1 February 1975. See Fox 1998 for an extended discussion of this Memorandum of Understanding, its modification and the consequences of Australian policy.

[17] A major study of these Bajau has been done by Natasha Stacey in an excellent thesis, *Boats to Burn: Bajo Fishing Activity in the Australian Fishing Zone* (Northern Territory University 1999).

By the time of this ban, trepang stocks were already depleted near all the reefs and islets identified by the Memorandum of Understanding. A stock assessment undertaken by CSIRO Marine Research in 1998 reported that "high value species were either absent or at low abundances on all reefs" covered under the Memorandum and that local gathering efforts had switched to medium and low value species but even these were at "low densities on most reefs". The ban of almost 15 years on gathering trepang at Ashmore had resulted in a partial recovery of trepang species but "even this reef showed some evidence of depletion" (CSIRO Executive Summary, August 2001).

Already by the mid-1990s, most voyages to Ashmore and other reefs in the Australian Fishing Zone to gather trepang had come to an end. The last perahu to sail for the Ashmore area to gather trepang were from the village of Oelaba in 1996-97. Earlier, at the beginning of the 1990s, substantial numbers of Bajau from Mola on Wanci Island had begun to move to Pepela, the largest of the fishing villages on Rote, which they used as their base for shark fishing further to the south. In turn, all of the fishers in Pepela, who had previously been trepang and trochus gatherers, learned shark fishing from the migrant Bajau and, as had the Bajau some years earlier, they quickly shifted from trepang and trochus gathering to intensive shark fishing.

Just as there are a great variety of trepang, so, too, there are a great variety of shark species and the market value for fin from different species varies significantly. A number of species are particularly targeted. Moreover, shark are a long-lived, slow-breeding species so that high-valued, high-targeted varieties can rapidly become depleted within defined areas. When fishing shifted to shark and more vessels entered Australian waters in search of these marine targets as the price of fin rose, fishermen – the Bajau and their 'pupils' from Pepela and Oelaba – began, almost inevitably, to venture beyond the permitted sea boundaries into the richer waters closely patrolled by the Australian Fishing Service. This has resulted in a massive apprehension of vessels for illegal fishing in the Australian Fishing Zone.

The dilemma is palpable. Throughout eastern Indonesia, local fisheries are under severe pressures exerted by larger, commercial and industrial ventures. The more mobile fishing populations survive by a style of fishing that often resembles 'raiding' – the intrusion (and in some cases, negotiated access) into the scattered local fisheries of more sedentary populations. The Ashmore Reef area is a microcosm of this dilemma. Despite official access provided by the Australian government, the resources of the area cannot support the pressure of use exerted by an increasing number of fishers. As alternative possible livelihoods have diminished in their own seas and as prices have risen for scarce commodities, more fishermen have been forced into taking greater risks by fishing beyond the boundaries allowed them within the Australian Fishing Zone in order to make an ever more precarious living.

The Atoni Pah Meto and the Trade in Sandalwood

No natural resource has been more significant than sandalwood (*Santalum album*) in the historical development of Timor.[18] This is the commodity that first attracted the attention of Chinese traders possibly as early as the 8th century and certainly by the 14th century. It enticed scores of traders from Java, Malacca, Luzon and, at a later date, from Makassar. It also drew the Portuguese to Timor and after them, the Dutch East India Company, if not so much to trade in this commodity as to prevent its trade by others. The trade in sandalwood gave rise to the authority of traditional Timorese polities, networks of ritual exchange that facilitated the passage of goods from the mountains to its coast and to the remarkable rise of the native polities led by the Topasses or Black Portuguese who rejected alignment with both Portuguese from Goa and Dutch from Batavia. By the 19th century, with the rise of other more powerful Timorese polities, the Topasses lost control over much of this sandalwood trade, but the trade in this aromatic timber was maintained, in diminished quantities, by Chinese merchants, who brought it from the coast in horse caravans. As the Dutch colonial government began progressively to exert its authority in the interior, it felt it necessary

[18] For discussion of sandalwood in the context of Timor's historical development, see Fox 1977:61-79, 1988, 2000b).

to intervene to conserve stocks of this precious timber – but with limited success. To most students of Timorese history, sandalwood has been seen as a poignant symbol of the depletion of a valuable resource. As I wrote in *Harvest of the Palm*, "sandalwood now stands as a symbol of [Timor's] past not its future" (1977b: 73).

In a recent paper, Andrew McWilliam has analyzed the continuing plunder of Timor's sandalwood in the 20th century and developed a number of critical insights on the possibilities of sandalwood in Timor's future. It is particularly interesting to compare the policies of both the Portuguese and Dutch toward sandalwood. Both colonial powers operated to restrain what was perceived as the 'rape of sandalwood' (Ormeling 1956:175). The effects of these policies, however, had the same unintended deleterious consequences.

Concerted Dutch pacification of West Timor began in 1906 and continued for the better part of the next decade or more. Portuguese pacification efforts in East Timor had begun earlier and culminated in final military subjugation after a major uprising in 1914. The Dutch Forestry Service began prohibiting free cutting and sale of sandalwood in some areas in 1916 and issued a Sandalwood Ordinance with further regulatory restrictions in 1925. The Forestry Service even attempted to develop a *cultuur contract* with local Timorese granting them access to arable land in return for tending sandwood plantings.

The Portuguese attempted to limit cutting earlier in the 20th century than the Dutch; they followed with a complete ban in 1925 when the Portuguese Forestry Service then assumed control of all reserves. The Indonesians, when they succeeded the Dutch in West Timor in 1950 and occupied East Timor in 1975, maintained more or less intact existing colonial regulatory frameworks.

These regulations severely restricted timber cutting by small holders on whose land the sandalwood grew. In West Timor, harvesting was – and continues to be – determined by government decisions based on stock inventory surveys. Local farmers

were allocated payments for cutting and gathering. These payments based on the amount of gathered sandalwood are supposed to be a percentage of the value of this timber. However, the government sets nominal prices for the sandalwood well below market prices. Farmers thus gain a mere pittance for the labour of harvesting their own timber. Farmers are expected to protect all sandalwood seedlings that sprout in their fields and conserve the trees to maturity for government harvest. For ordinary cultivators, the appearance of sandalwood in a cultivated field is a cause of threatening imposition. I once happened to be with a farmer in Amarasi who discovered a shoot of sandalwood growing in his dry field. Imploring me not to tell the 'government', he immediately uprooted the stalk and systematically traced its roots through his garden, pulling them up as he went.

The Atoni Pah Meto of West Timor refer to sandalwood as *hau meni*: 'fragrant wood'. As a mature plant, it is a grey-trunked, straggly branched ten-meter tree with ovate grey-green leaves. The small leafed variety (*noh mnutu*) is favoured by Timorese because it matures more quickly. Trees can take up to 50 years to mature and can produce up to 110 kg of dry heartwood. Most of the tree's oil is produced in its roots.

Sandal is a semi-root parasite, which requires a range of suitable host plants. Although it can grow from seed, in Timor it mainly propagates itself by vegetative regrowth along the lateral roots of maturing trees. A 'mother' tree can give rise to dozens of new saplings. 40 regrowth saplings were recorded within 8 meters of one 37 year old 'mother' tree in south central Timor – the traditional heartland of Timorese sandalwood cultivation.[19] Significantly vegatative regrowth appears to be enhanced by fire which induces scorching and fissuring in lateral roots, thus promoting further shoot regrowth. Thus local swidden cultivation techniques encourage the rapid growth of sandalwood whereas supposedly well-intended local government policies of

[19] See McWilliam, 'Haumeni, Not Many', in press: p.27 for information on the agroforestry of sandalwood in Timor and local government policies for its cultivation.

the past century have disenfranchised local swidden cultivators from the products of their fields and prompted a continuing decline in the number of trees on Timor.

In 1996, the provincial government of West Timor passed a decree granting individuals ownership of sandalwood trees on their land but the government still insists on maintaining control over the sale of sandalwood, allowing farmers only about 7.5% of the market price of the commodity. This in turn has encouraged continuing illegal logging and surreptitious export by government officials, the military and the police.

The case of sandalwood on Timor can be taken as indicative of a tendency that began in the colonial period and has been greatly augmented since independence. The state has intervened to control and regulate a resource without fully understanding the social ecology of the resource it is trying to manage nor the implications for smallholders of the policies that it is applying.

Conclusions

This paper could well be called a 'lament' with two case studies, neither of which is optimistic or encouraging. In terms of the lament in this paper, the question to ask is this: If in a single generation so much destruction, degradation and outright pillage of Indonesia's natural resources have occurred, what will happen in the next generation? At the moment, the outlook is bleak. On current evidence, the rate of on-going destruction has not decreased and may perhaps be escalating.

Each of the case studies I have presented exemplifies this destruction at a micro-level but each case also offers possible lessons for the future. The first of these lessons is probably the most fundamental. Until one understands a resource, it is difficult to begin to formulate policies to manage it properly. Certainly over the past generation, we have gained a greater (but by no means adequate) understanding of the resource

ecology of Indonesia. What is still needed is a greater understanding of the social ecology of resource use in Indonesia.

We have all come to realize that various optimistic and possibly well-intentioned policies have not achieved their end but instead have contributed to a growing problem. The role of the state to regulate from on-high is a flawed procedure but a lack of regulation – or the regulation of resources by market forces (which has never occurred) – provides no solution either. Internal as well as external demand for resources continues to increase. Who has rights to these resources and who may thereby allocate them to meet these demands remains an unanswered question and whether those who have the right to resources will allocate them responsibly is no less clear. The present hope – and it is only a hope – is that by redistributing rights more equitably to the communities directly linked to these resources, we will restructure a balance that has been sadly disrupted and rekindle a commitment in local communities to the welfare of future generations. We can only hope and continue to strive for something that we call 'sustainability' – even when we ourselves do not understand its full meaning.

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