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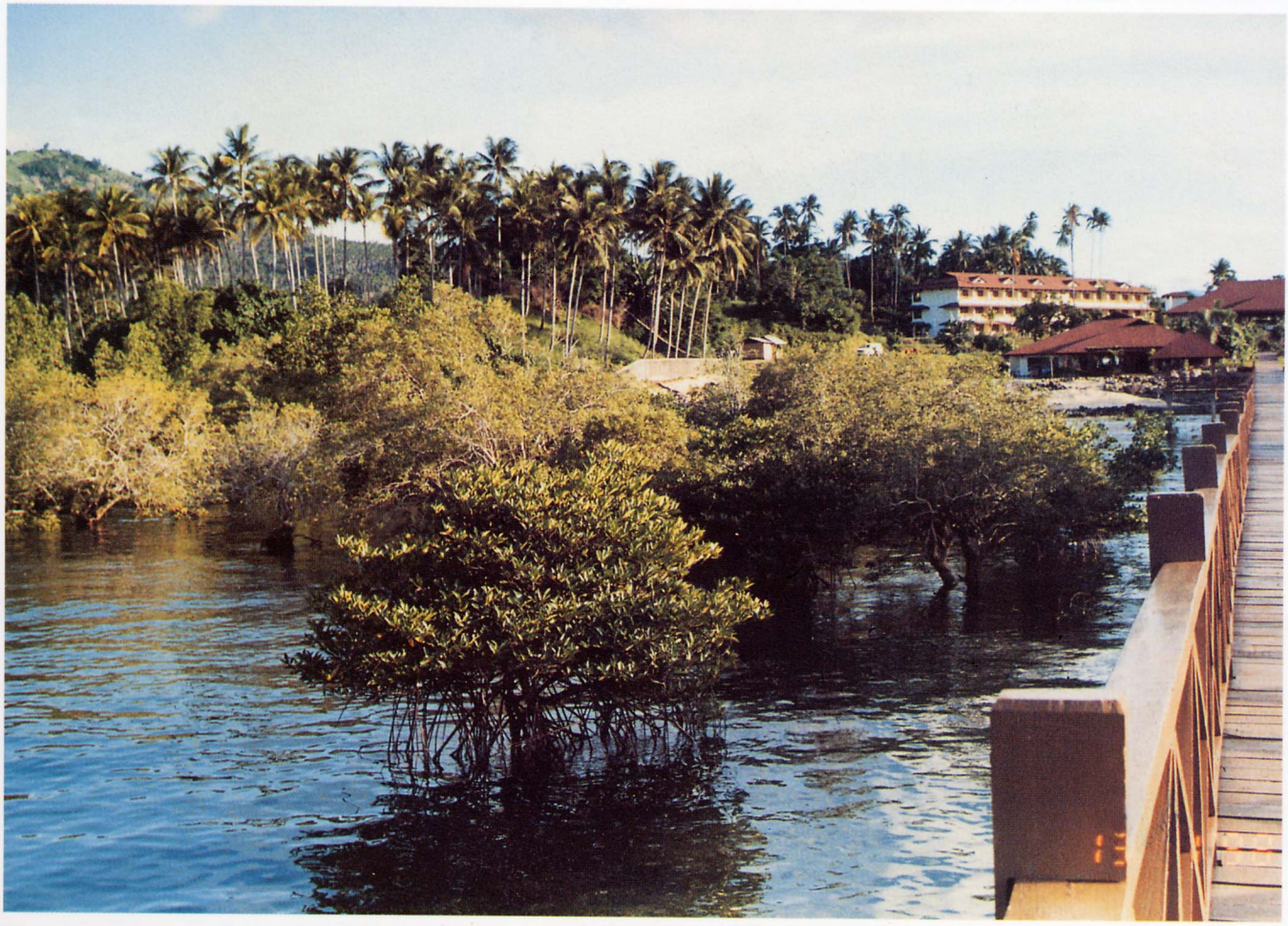

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Halaman muka (cover): Pesisir Molas, Minahasa, Sulawesi Utara
(Coastal Area of Molas, Minahasa District, North Sulawesi)
(Photo: Dietriech G. Bengen, 2000)

ANALISIS PEMANFAATAN RUANG KAWASAN PESISIR TELUK MANADO, SULAWESI UTARA (The Space Use Analysis of Manado Bay Coastal Zone, North Sulawesi)

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ABSTRACT

This research was conducted from March to July 2000, and located in the coastal zone of Manado Bay. The research aimed to (a) identify the spatial use of Manado Bay coastal zone, (b) analyze the spatial use consistencies against land use plan for Manado, and compatibility of that use, (c) describe the spatial arrangement of the Manado Bay coastal zone, (d) analyze spatial use conflicts in the coastal zone.

Geographic Information System (GIS) analysis was used for evaluating spatial use, and Analytical Hierarchy Process (AHP) method was used for resolving land use conflict in Manado Bay coastal zone.

The result showed a divergence of spatial use of both settlement areas and tourism areas as well as conservation areas, respectively. However, Manado Harbor was not changed. Futhermore, the result showed the most suitable area in Manado City as follow (a) the developing of tourism area was located at Tongkaina, Molas, Bunaken, Malalayang I, Malalayang II and Wenang Utara, (b) the developing of harbor area was recommended with emphasis on improving public service and preservation of environment in this area, (c) the developing of settlement area was recommended to develop at Eastern and Southern of Manado City such as Mapanget and Malalayang Districts, respectively, and (d) the developing of conservation area located at Manado City and Manado Bay must emphasize the improvement and preservation according to the land use plan designed for ten years ahead (2000-2010) to avoid problems in those uses.

Key words: Manado Bay, Analytical Hierarchy Process (AHP), the land use plan.

ABSTRAK

Penelitian ini dilaksanakan dari bulan Maret sampai dengan Juli 2000, berlokasi di wilayah pesisir Teluk Manado. Tujuan penelitian ini adalah untuk (a) mengidentifikasi pemanfaatan ruang wilayah pesisir Teluk Manado, (b) menganalisis konsistensi pemanfaatan ruang terhadap RUTRK Manado, dan membandingkan kompatibilitas pemanfaatannya, (c) menguraikan pengaturan ruang wilayah pesisir Teluk Manado, (d) menganalisis konfik pemanfaatan ruang dalam wilayah pesisir dengan menggunakan metode Proses Hierarki Analitik (PHA).

Analisis Sistem Informasi Geografis (SIG) digunakan untuk mengevaluasi pemanfaatan ruang dan metode PHA digunakan untuk memecahkan konflik pemanfaatan lahan wilayah pesisir di Teluk Manado. Hasil penelitian menunjukkan bahwa terdapat penyimpangan pemanfaatan ruang dari RUTRK baik untuk kawasan permukiman an kawasan pariwisata maupun kawasan konservasi. Selanjutnya hasil penelitian menunjukkan kawasan yang esuai dengan pemanfaatan ruang di Kota Manado adalah sebagai berikut: (a) pengembangan kawasan pariwisata di Tongkaina, Molas, Bunaken, Malalayang I, Malalayang II dan Wenang Utara, (b) pengembangan kawasan pelabuhan disarankan untuk ditekankan pada perbaikan jasa publik dan pelestarian lingkungan dalam kawasan ini, (c) pengembangan kawasan permukiman disarankan untuk membangun Kota Manado Timur dan Selatan, seperti, Kecamatan Mapanget dan Kecamatan Malalayang, (d) pengembangan kawasan konservasi di Kota Manado dan Teluk Manado harus sesuai dengan RUTRK yang didesain untuk 10 tahun mendatang (2000-2010) dalam upaya menghindari permasalahan dalam pemanfaatan ruang tersebut.

Kata Kunci: Teluk Manado, Proses Hierarki Analitik (PHA), Rencana Umum Tata Ruang Kota.

PENDAHULUAN

Kemajuan pesat yang dicapai dalam pembangunan guna peningkatan taraf hidup masyarakat ternyata diiringi oleh kemunduran kemampuan sumberdaya alam sebagai penyangga kehidupan. Di samping itu pelaksanaan pembangunan yang makin beragam juga menghasilkan produk sampingan berupa limbah, sampah dan buangan lainnya. Hal ini perlu diantisipasi secara dini agar tidak melampaui ambang batas dan daya dukung lingkungan.

Masalah lingkungan hidup semakin berkembang dan kompleks seiring dengan bertambahnya jumlah penduduk. Peningkatan pembangunan telah mengakibatkan pergeseran pola pemanfaatan lahan dan tidak sesuai lagi dengan kaidah penataan ruang, daya dukungnya serta kesesuaian lahan. Di samping itu, sering terjadi pemanfaatan kawasan yang seharusnya merupakan kawasan lindung sebagai lokasi kegiatan yang tidak bersifat kegiatan perlindungan, sehingga terjadi perubahan fungsi dan tatanan lingkungan.

Essensi penataan ruang menurut Undang-undang No. 24 tahun 1992 adalah proses perencanaan tata ruang, pemanfaatan ruang dan pengendalian pemanfaatan ruang (pasal 13, 15, dan 17 UU No. 24 1992). Perencanaan tata ruang pada dasarnya merupakan perumusan penggunaan ruang secara optimal dengan orientasi produksi dan konservasi bagi kelestarian lingkungan. Perencanaan Tata Ruang Wilayah mengarah dan mengatur alokasi pemanfaatan ruang, mengatur alokasi kegiatan, keterkaitan antar fungsi kegiatan, serta indikasi program dan kegiatan pembangunan. Penyusunan rencana tata ruang harus selalu dilandasi pemikiran perspektif menuju ke masa depan yang didambakan, bertitik tolak dari data, informasi, ilmu pengetahuan dan teknologi yang berkembang pesat seiring dengan berjalannya waktu. Oleh karena itu, agar rencana tata ruang yang telah disusun tetap sesuai dengan tuntutan pembangunan, maka rencana tata ruang dapat ditinjau kembali atau disempurnakan secara berkala.

Identifikasi dan perumusan masalah

Propinsi Sulawesi Utara merupakan wilayah yang potensial serta menempati posisi geografis yang strategis, terdiri atas semenanjung dan kepulauan dengan garis pantai sepanjang 1.985 Km, dan luas lautan sebelas kali luas daratan. Wilayah ini berbatasan dengan negara tetangga Filipina serta memiliki potensi sumberdaya pesisir dan laut yang besar, baik sumberdaya dapat pulih (terumbu karang, mangrove), maupun sumberdaya tidak dapat pulih (mineral dan energi), serta jasa-jasa kelautan (pariwisata bahari, perhubungan). Potensi yang demikian besar merupakan tumpuan pembangunan bagi propinsi di ujung utara pulau Sulawesi dengan ibukotanya Manado. Kota Manado dengan segenap aktivitas dan pemukimannya serta derap pembangunan yang sangat intensif, berada di kawasan pesisir Teluk Manado. Kenyataan menunjukkan bahwa besarnya tekanan penduduk dengan dinamika sosialekonominya, serta besarnya tuntutan Pemerintah Daerah untuk memperoleh sumber dana bagi peningkatan akselerasi pembangunan, telah memberikan dampak yang kurang menguntungkan bagi keberkelanjutan lingkungan hidup dan sumberdaya alam yang menjadi modal pembangunan masa kini dan masa mendatang. Hal ini ditunjukkan dengan adanya lingkungan (perumahan) kumuh, kesenjangan sosial, pencemaran, erosi, degradasi fisik habitat penting, over-eksploitasi sumberdaya serta konflik penggunaan ruang/tanah dan sumberdaya yang akhirnya mengancam kelestarian lingkungan dan pembangunan yang berkelanjutan.

Berdasarkan permasalahan di atas dapat dirumuskan:

1. Adanya kesenjangan perencanaan dalam alokasi penetapan skala prioritas pembangunan, baik perencanaan sentralistis *(top-down planning)* maupun perencanaan partisipatif *(bottom-up planning)*.
2. Adanya pemusatan kegiatan ekonomi pada wilayah pesisir Kota Manado, sehingga dapat mengakibatkan konflik penggunaan lahan yang sangat sulit diselesaikan, yang pada akhirnya dapat menurunkan kualitas sumberdaya pesisir tanpa ada yang bertanggung jawab terhadap sumberdaya tersebut.
3. Adanya pergeseran prioritas pembangunan yang tidak berorientasi pada pengentasan kemiskinan serta tidak adanya disiplin tata ruang yang berakibat pada penyimpangan tata ruang.

4. Kurangnya orientasi pembangunan yang seimbang antara Bagian Wilayah Kota (BWK) satu dengan yang lainnya, sehingga penyebaran penduduk tidak merata.

Tujuan dan Manfaat Penelitian

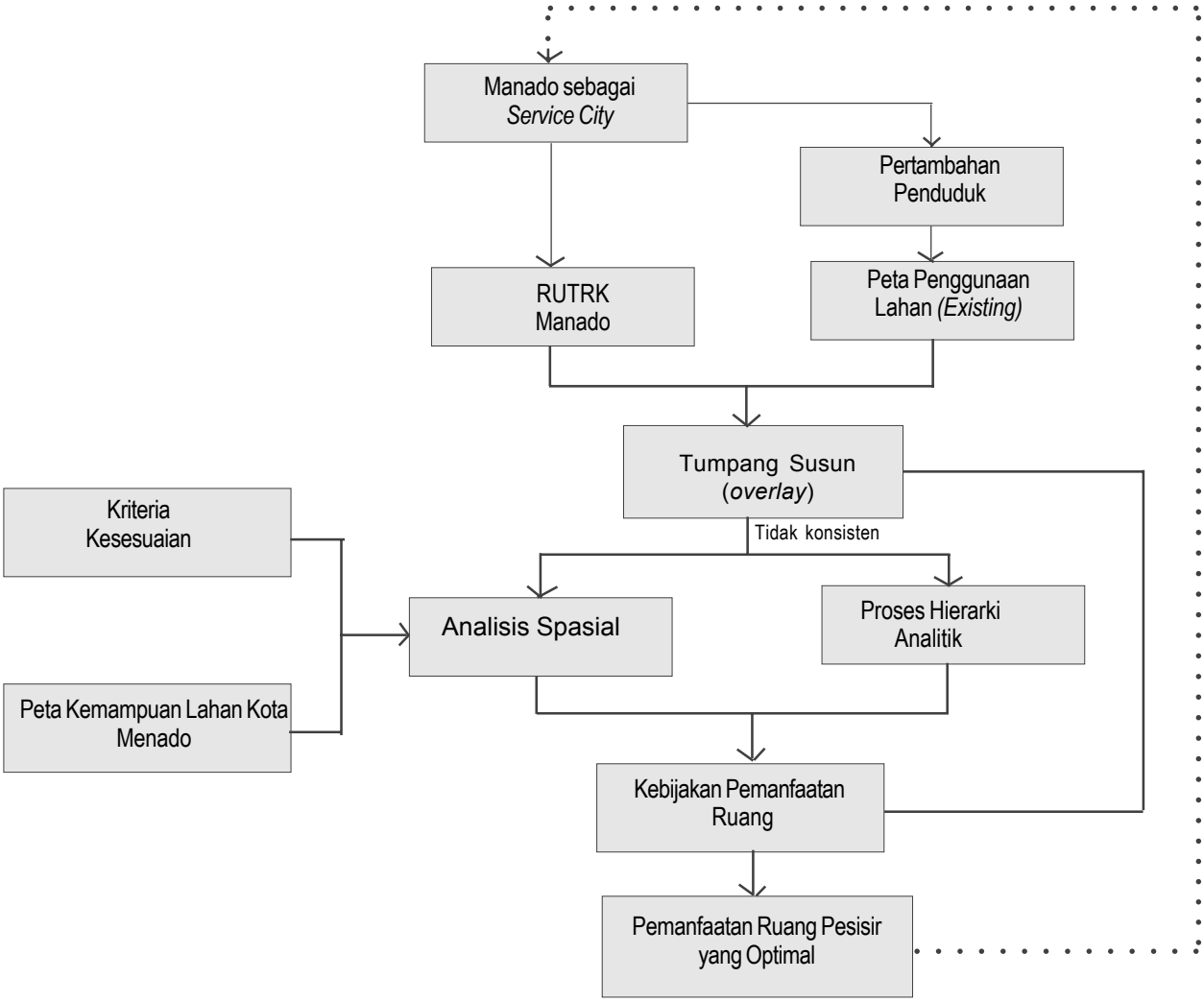
Penelitian ini bertujuan:

a. Mengidentifikasi pemanfaatan ruang kawasan pesisir Teluk Manado.
b. Menganalisis konsistensi pemanfaatan ruang yang sekarang terhadap RUTRK serta menganalisis kesesuaian pemanfaatannya.
c. Memberikan deskripsi tata ruang kawasan pesisir Teluk Manado dengan memanfaatkan Sistem Informasi Geografis (SIG) sehingga konsep pembangunan berkelanjutan dapat diterapkan secara komprehensif.
d. Menganalisis konflik dalam pemanfaatan ruang wilayah pesisir dengan menggunakan Proses Hierarki Analitik(PHA) sehingga terjadi sinergi yang menguntungkan bagi semua pihak.

Penelitian ini diharapkan dapat menjadi bahan pertimbangan bagi Pemerintah Daerah dalam pengambilan kebijakan pembangunan wilayah pesisir, khususnya wilayah pesisir Kota Manado yang berorientasi pada pembangunan berkelanjutan.

Kerangka pendekatan masalah

Kesadaran akan keperluan data untuk perencanaan dan pemanfaatan sumberdaya alam (lahan) sudah ada sejak lama dan kemauan politis untuk pendataan secara terpadu dengan kegiatan inventarisasi multi-disiplin telah dicoba untuk menghasilkan sesuatu, namun pengakuan dari hasil kegiatan tersebut masih mengalami kendala. Indikasi ini tercermin pada masalah pemanfaatan ruang kawasan pesisir khususnya Teluk Manado dengan konflik yang menonjol, adanya reklamasi pantai.



Gambar 1. Diagram Kerangka Pendekatan Masalah.

Data perluasan Kota Manado yang sesuai dengan PP No. 22 tahun 1988, menunjukkan bertambahnya lahan permukiman dan daerah terbangun. Hal ini disebabkan oleh tekanan penduduk dan tuntutan perkembangan ekonomi global, serta ketidakserasian sektoral. Mempelajari permasalahan yang ada dalam pemanfaatan ruang, pada dasarnya dapat dilakukan eliminasi masalah dengan perencanaan yang lebih cermat dan arif untuk menghindari konflik, melalui pilihan pemanfaatan ruang yang lebih mengakomodir kebutuhan nyata. Dalam konteks ini lebih ditekan pada kebutuhan berdasarkan persyaratan budidaya (*cultivation requirement*), persyaratan pengelolaan (*management requirement*) dan persyaratan konservasi (*conservation requirement*) untuk mencapai penataan ruang yang memadai. Adapun kerangka pendekatan masalah pemanfaatan ruang kawasan pesisir Teluk Manado dilakukan dengan suatu pendekatan sistem, sebagaimana disajikan dalam Gambar 1.

METODE PENELITIAN

Lokasi dan waktu penelitian

Lokasi penelitian terletak di Kota Manado, Propinsi Sulawesi Utara dengan luas daerah penelitian sebesar 15.726 ha (Gambar 2). Pengumpulan data primer dan sekunder dilakukan selama 5 bulan, dari bulan Maret hingga bulan Juli 2000.

Pengumpulan data dan informasi

Data yang dikumpulkan adalah data primer dan data sekunder, dimana data primer dilakukan dengan survei dan mewawancarai sejumlah responden (32 responden yang mempunyai kemampuan dan pengetahuan tentang permasalahan terkait) yang dilakukan di wilayah pesisir Kota Manado.

Metode analisis data

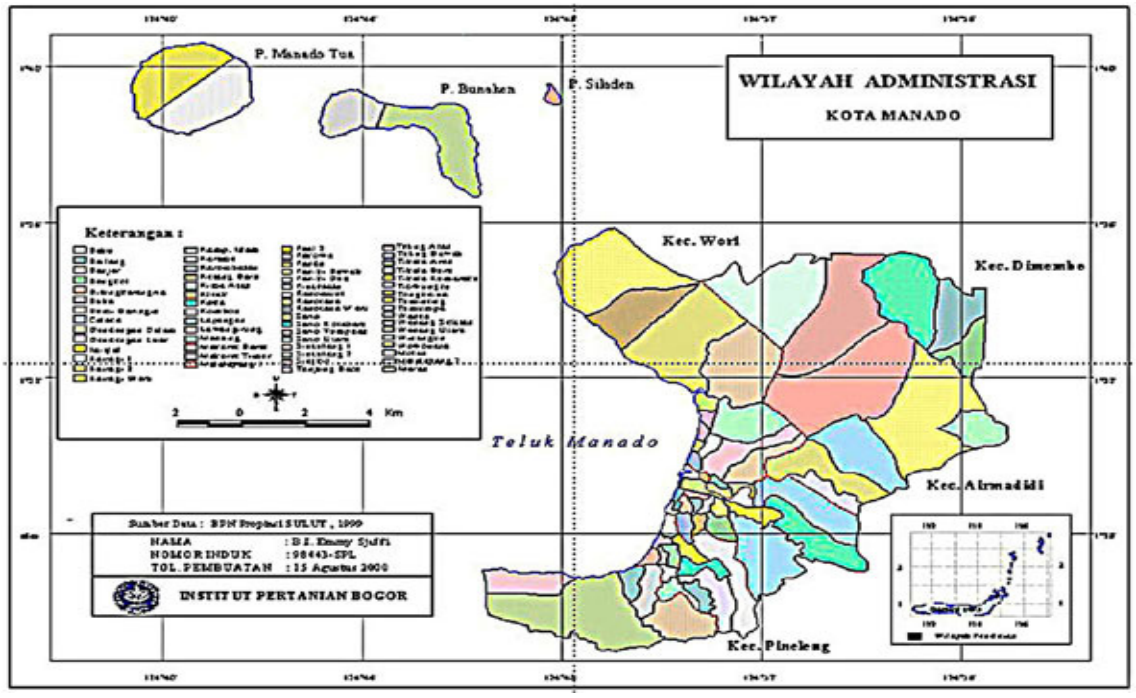
Metode analisis data yang digunakan dalam penelitian ini adalah :

1. Analisis spasial (keruangan) dan atribut dengan menggunakan Sistem Informasi Geografis (SIG) untuk mengetahui penyimpangan pemanfaatan ruang.
2. Pendekatan Proses Hierarki Analitik (PHA) digunakan untuk memecahkan konflik pemanfaatan ruang di kawasan pesisir Teluk Manado.

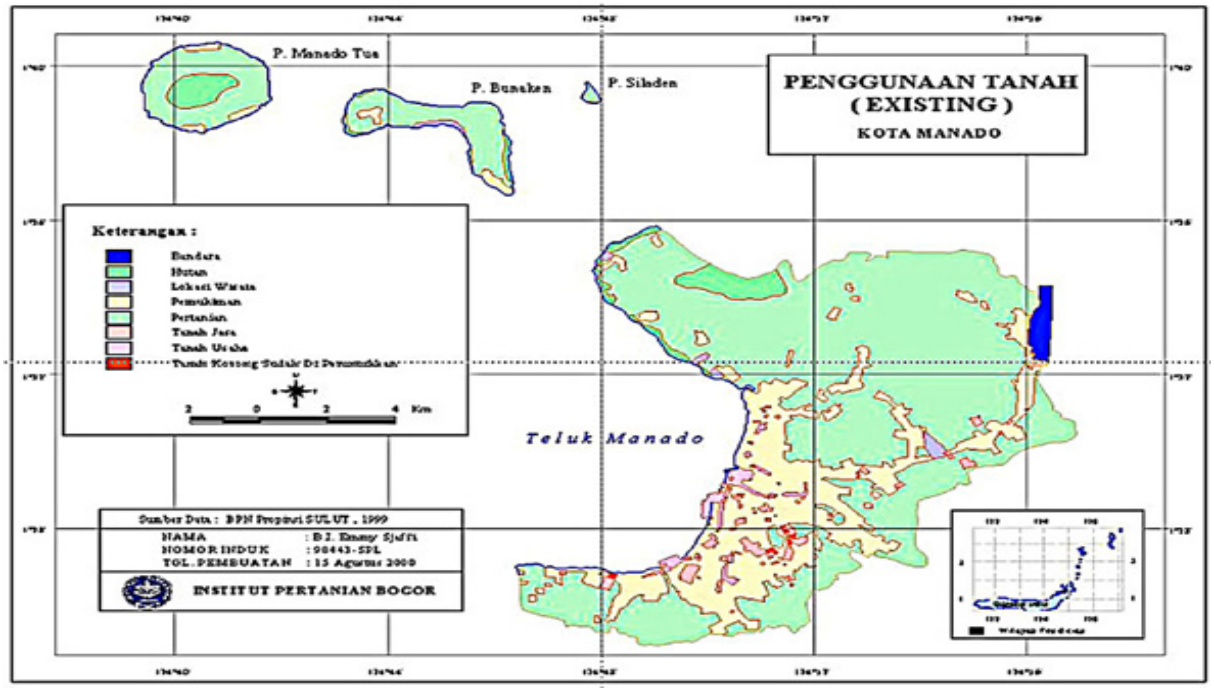
HASIL DAN PEMBAHASAN

Aspek pemanfaatan ruang kota

Pemanfaatan ruang/lahan secara keseluruhan di Kota Manado didominasi oleh lahan pertanian/ perkebunan seluas 11.037,10 ha; diikuti oleh perumahan seluas 3.598,83 ha; hutan seluas 662,70 ha; bandara seluas 169,44 ha; lokasi wisata seluas



Gambar 2. Peta Wilayah Administrasi Kota Manado

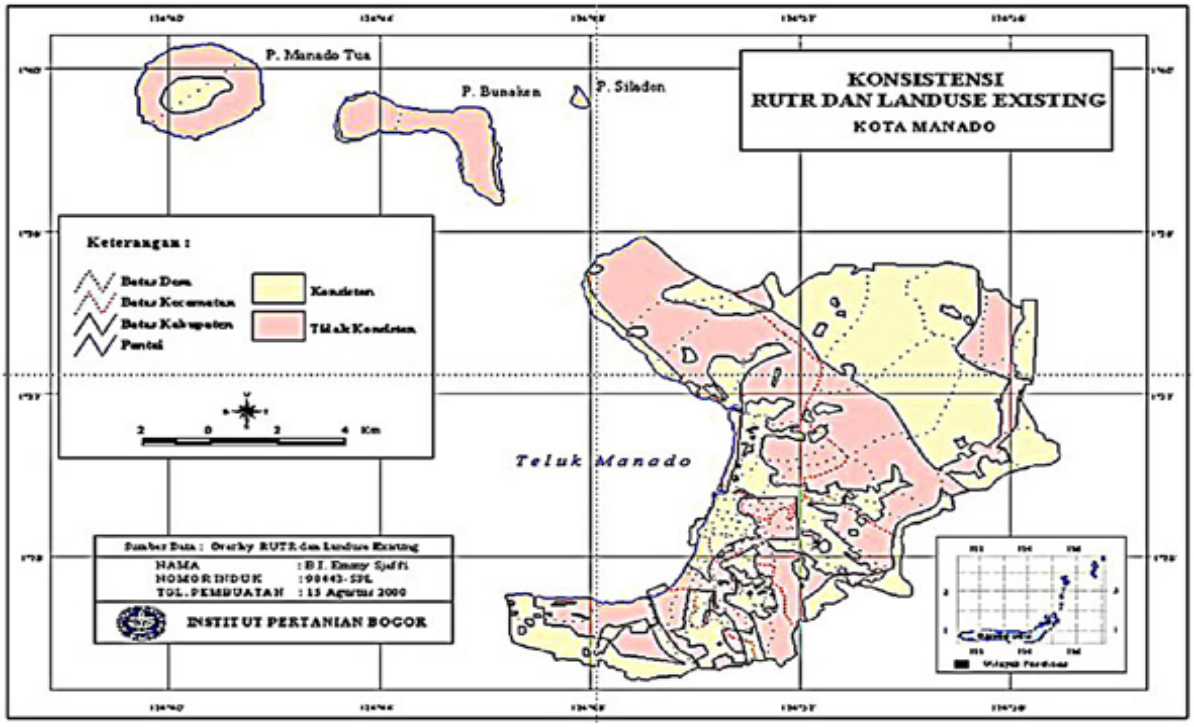


Gambar 3. Peta Penggunaan lahan (*existing*) Kota Manado

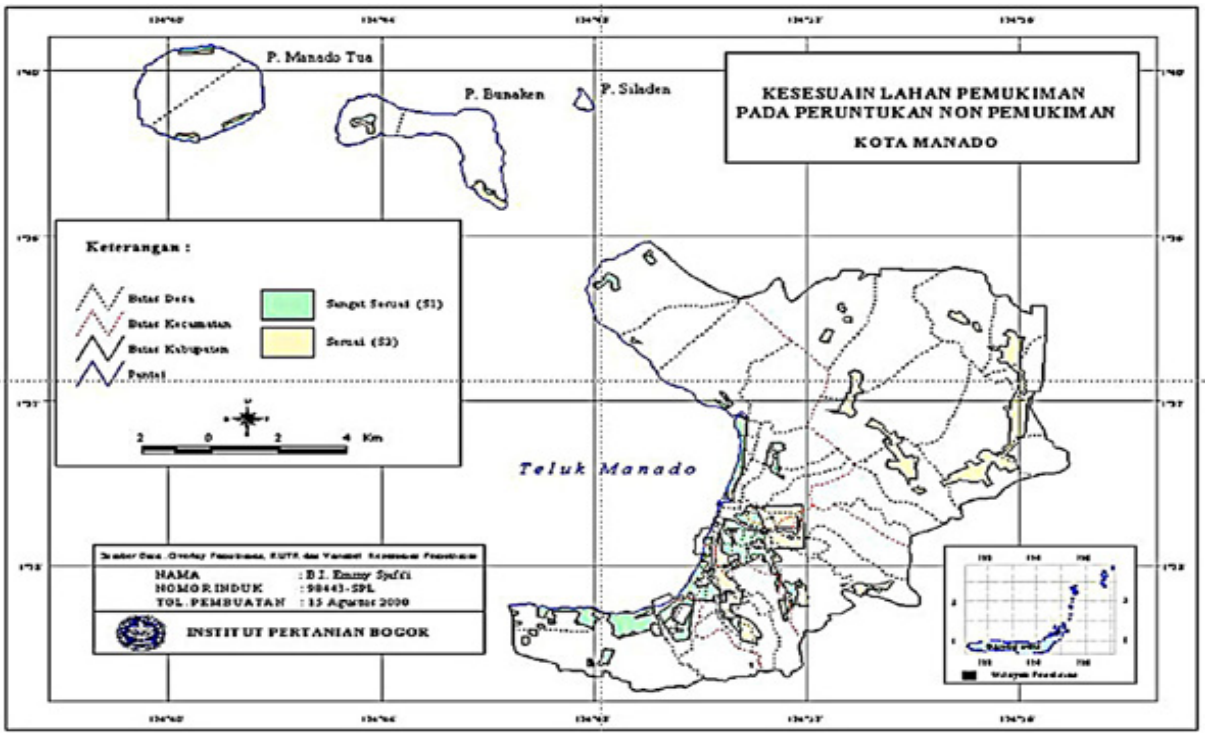
114,11 ha;, lahan jasa seluas 261,87 ha; lahan usaha seluas 190,63 ha; dan lahan kosong yang sudah diperuntukkan seluas 18,75 ha (lihat Gambar 3). Namun demikian, bila dilihat per Kecamatan, luas lahan yang digunakan untuk pertanian/perkebunan dan perumahan tidak mempunyai prosentase yang sama. Kawasan pertanian/perkebunan mendominasi sebesar 65% penggunaan lahan di Kecamatan Malalayang, 85% penggunaan lahan di Kecamatan Mapanget, dan 75% penggunaan lahan di Kecamatan Molas. Sedangkan kawasan perumahan mendominasi sebesar 55% pemanfaatan lahan di Kecamatan Sario dan 45% pemanfaatan di Kecamatan Wenang. Di antara ke tiga kecamatan yang pemanfaatan lahannya didominasi oleh pertanian/perkebunan, Kecamatan Malalayang paling cepat mengalami perubahan fungsi lahan dari kawasan pertanian/perkebunan menjadi kawasan perumahan. Hal ini disebabkan karena kebijaksanaan Pemerintah Daerah selama ini berupa pembangunan fasilitas Rumah Sakit Umum (RSU) Malalayang, pembangunan perumahan (KPR) serta rencana pembangunan kampus Universitas Sam Ratulangi di Sea telah memicu perkembangan kota ke arah Barat.

Konsistensi pemanfaatan ruang kota

Dari hasil tumpang-susun antara peta RUTRK Manado 1990-2010 (1994) dengan peta penggunaan lahan (1999) dari BPN Manado, terlihat adanya perubahan penggunaan ruang di Kota Manado (Lihat Gambar 4). Areal penggunaan ruang/lahan untuk Pelabuhan Manado relatif tetap, sedangkan penggunaan lahan untuk permukiman terjadi penambahan ruang yang cukup berarti. Dalam RUTRK Manado diprediksi hingga tahun 2010 penggunaan lahan untuk perumahan/ permukiman seluas 2.456,47 ha, namun kenyataannya luas aktual dari BPN Manado telah mencapai 3.598,8 ha. Dari luas aktual ini, yang konsisten dengan RUTRK Manado adalah seluas 1.667,2 ha, sedangkan yang tidak konsisten seluas 1.931,6 ha. Selanjutnya dari luas penggunaan lahan yang tidak konsisten setelah dianalisis lebih lanjut dengan memasukkan kriteria kesesuaian lahan, diperoleh hasil, yaitu: Sangat Sesuai (S1) sebesar 796,3 ha, dan Sesuai (S2) sebesar 1.135,3 ha (Lihat Gambar 5). Penambahan jumlah areal permukiman ini disebabkan oleh adanya pertambahan jumlah penduduk dari waktu ke waktu sesuai dengan perkembangan kota. Dalam RUTRK dijelaskan bahwa semua bagian wilayah kota (BWK) diperuntukkan bagi permukiman pada lokasi tertentu, mengingat fungsi kota sebagai pusat pemerintahan dan pelayanan, namun prediksi penggunaan lahan hingga tahun 2000, untuk pengembangan kawasan permukiman telah melampaui luas yang ditargetkan.



Gambar 4. Peta Konsistensi RUTR dan Penggunaan Lahan aktual Kota Manado

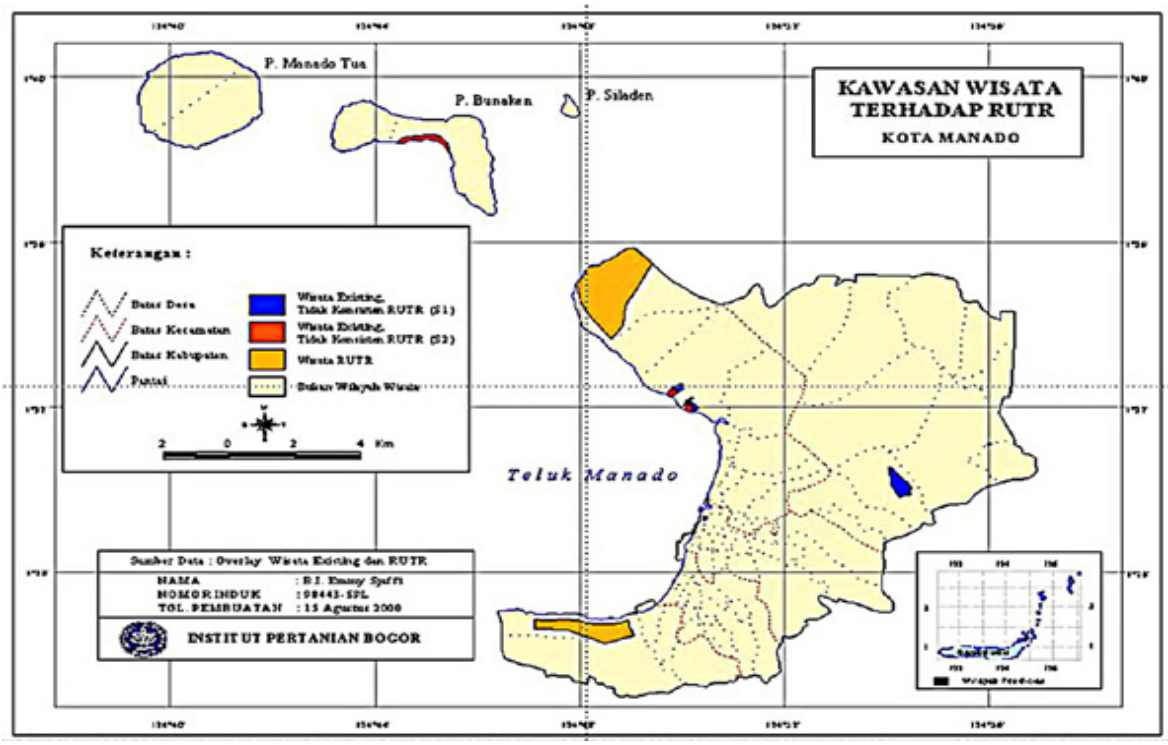


Gambar 5. Peta Kesesuaian Lahan Pemukiman pada Peruntukan Non Pemukiman Kota

Selanjutnya dalam RUTRK Manado, penggunaan lahan untuk sektor pariwisata hingga tahun 2010 ditargetkan seluas 416,47 ha (tahun 2000 seluas 391,74 ha). Jika dilihat dari penggunaan lahan aktual pada sektor ini belum mencapai luas yang ditargetkan, karena hasil yang dicapai hingga tahun 2000 seluas 114,1 ha. Selanjutnya dari luas yang dicapai pada sektor ini, yang konsisten dengan RUTRK hanya 12,6 ha, sedangkan yang tidak konsisten adalah 101,5 ha yang terletak di kawasan konservasi DAS Tondano dan kawasan konservasi pulau Bunaken. Jika kita masukkan kriteria kesesuaian lahan untuk pengembangan kawasan pariwisata didapat 2 kategori kesesuaian lahan yaitu: Sangat Sesuai (S1) seluas 59,6 ha dan Sesuai (S2) seluas 41,9 ha (Lihat Gambar 6).

Selanjutnya penggunaan lahan untuk kegiatan konservasi belum mencapai luas yang ditargetkan, bahkan lahan yang diperuntukkan bagi kawasan ini mengalami pengurangan yang cukup drastis dari keadaan semula (tahun 1988). Dalam RUTRK Manado luas yang ditarget hingga tahun 2010 seluas 2.986,86 ha (tahun 2000 seluas 2.862,38 ha), namun yang direalisasi pada penggunaan aktual hanya seluas 662,7 ha. Dari luas ini yang konsisten dengan RUTRK Manado seluas 559,3 ha, sedangkan yang tidak konsisten seluas 103,4 ha yang berada pada lahan pariwisata di Tg. Pisok dan lahan pertanian di sekitar G. Tumpa. Bila kawasan ini dikembangkan untuk kegiatan konservasi dengan memasukkan criteria kesesuaian lahan maka hasilnya hanya terdapat satu macam kategori kesesuaian lahan, yaitu Sangat Sesuai (S1) semuanya (Lihat Gambar 7).

Berdasarkan penggunaan ruang yang dominan di kawasan pesisir Teluk Manado, ditinjau dari aspek kesesuaian lahan untuk kawasan terbangun, perlu diperhatikan indikator-indikator yang membatasi penggunaannya agar tidak menimbulkan dampak yang serius bagi keberlangsungan sumberdaya alam baik yang pulih maupun tidak pulih. Sebagaimana kita ketahui bahwa pengelolaan di lahan atas dapat menimbulkan dampak di daerah bawah, sehingga segala sesuatu yang akan dilakukan di lahan atas harus



Gambar 6. Peta Kawasan Wisata Terhadap RUTR Kota Manado

benar-benar diperhitungkan akibat ikutannya.

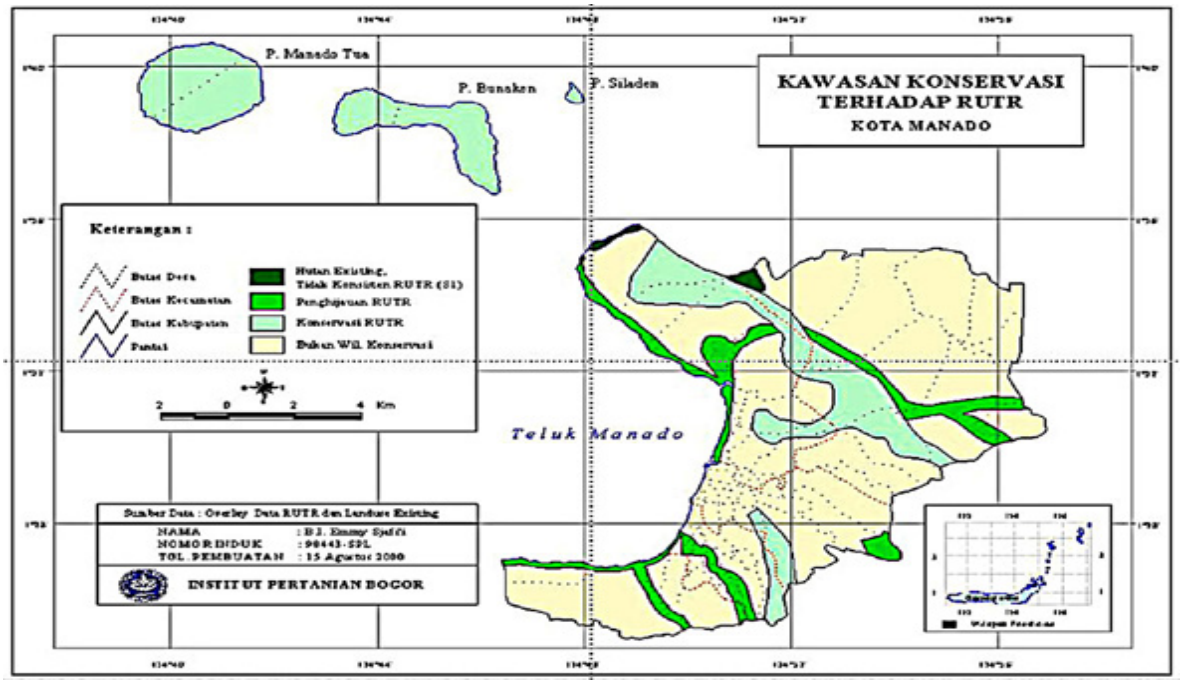
Berikut ini diuraikan tentang pola dan rencana pemanfaatan ruang wilayah pesisir Teluk Manado untuk pengembangan kawasan pariwisata, pelabuhan Manado, permukiman serta konservasi sesuai dengan fokus penelitian ini.

1. Kawasan pariwisata

Pengembangan kawasan untuk kegiatan pariwisata sesuai RUTRK Manado pada dasarnya diarahkan di BWK X (Wilayah Pengembangan Molas) dengan obyek wisata alamnya, yaitu TNL Bunaken, pantai pasir putih pulau Siladen dan pendakian gunung di pulau Manado Tua. Untuk obyek wisata buatan manusia adalah Taman Anggrek, Taman Kesatuan Bangsa, Klenteng Ban Hin Kiong dan jalan Pierre Tendean/Boulevard yang berada di BWK I (Wilayah Pengembangan Pusat Kota), BWK II (Wilayah Pengembangan Malalayang) dan BWK III (Wilayah Pengembangan Bahu).

Dewasa ini di wilayah pesisir Teluk Manado dari Kecamatan Malalayang, banyak dibangun hotel-hotel berbintang, antara lain Hotel Sedona, Happy Beach, Novotel, hingga hotel Santika di Kecamatan Molas desa Tongkaina. Bahkan di sepanjang jalur jalan Boulevard telah menjamur restoran ataupun tempat hiburan lainnya. Ini artinya masyarakat telah turut berpartisipasi menunjang program pemerintah di sektor pariwisata (salah satu Panca Program Unggulan Sulut).

Pengembangan kawasan pariwisata di Kecamatan Wenang dan Sario yang padat penduduknya serta melebihi kapasitas tampung, dimana tidak dimungkinkan lagi tersedianya lahan untuk pembangunan kawasan pariwisata maka oleh Pemerintah Daerah diberikan ijin untuk mereklamasi Teluk Manado. Perlu diketahui bahwa pengembangan suatu kawasan untuk kegiatan pariwisata, bukan hanya dilihat dari kemegahan fisiknya saja, tetapi yang lebih penting bagaimana jenis, frekwensi dan kualitas dari agenda pariwisata itu sendiri. Kegiatan reklamasi pantai Teluk Manado harus benar-benar memperhitungkan resiko yang bakal muncul, baik dampak langsung maupun yang tidak langsung.



Gambar 7. Peta Kawasan Konservasi terhadap RUTR Kota Manado

Menurut Salim (1993), pembangunan memuat kegiatan merubah lingkungan. Setiap media lingkungan memiliki ambang batas baku mutu lingkungan. Semakin longgar ambang batas baku mutu lingkungan, maka semakin terganggu fungsi lingkungan, dan semakin kurang baik kualitas lingkungan. Di samping itu konflik utama dalam pemanfaatan ruang adalah pengalihan fungsi ruang yang satu menjadi fungsi yang lain, yang berakibat pada kemerosotan sumberdaya yang ada.

Selanjutnya kebijakan Pemerintah Daerah Kota Manado dalam rangka mengatasi keterbatasan ruang dalam konteks pembangunan, maka laut menjadi salah satu alternatif jalan keluar melalui reklamasi pantai Teluk Manado. Kebijakan reklamasi pantai ini, di samping bertujuan untuk menyiapkan kawasan baru yang nantinya akan menyemarakkan kegiatan bisnis sebagai alternatif investasi terpadu yang memacu keramaian kota, juga untuk meningkatkan daya tarik Kota Manado dari arah pantai dengan konsep "*Water Front City*" di samping itu dapat menahan abrasi pantai.

Dari hasil pengamatan di lapangan, reklamasi yang direncanakan oleh pengembang seharusnya sudah selesai dilaksanakan dan sudah mulai pada tahap pembenahan untuk kegiatan operasional, namun sayangnya hingga saat ini baru sekitar 15 ha yang dijamah dari luas total 63,5 ha. Inipun ada beberapa lokasi yang sudah mulai rusak (*tafiaro*) akibat beberapa kali diterpa ombak. Di samping itu ada beberapa kegiatan pemanfaatan lahan di lokasi ini tidak sesuai dengan *master plan* yang dibuat, contohnya pembangunan Marina Blue Banter oleh pihak Ritzi (Novotel). Bertitik tolak dari permasalahan di atas, maka perlu ditinjau kembali pihak pengembang yang sudah mendapat ijin, namun belum melaksanakan pekerjaannya. Selanjutnya pihak Pemerintah Daerah diharapkan lebih meningkatkan pengawasan untuk mengantisipasi dampak yang timbul akibat reklamasi, terutama pada tahap konstruksi dan tahap operasional.

2. Pelabuhan Manado

Identitas awal Kota Manado adalah kota pelabuhan, sekaligus simbol dari benteng perlawanan rakyat melawan kolonialisme di masa lalu. Sebagai kota pelabuhan, Manado beridentitaskan masyarakat yang majemuk, dinamis sekaligus terbuka. Di samping itu struktur ruang wilayah kota secara signifikan merupakan masyarakat pulau-pulau kecil di sekitarnya, seperti Manado Tua, Siladen dan Bunaken serta etnis Sangir yang termasuk ke-empat etnis "Bohusami" yang ada di Sulawesi Utara.

Dilihat dari data serta kenyataannya bahwa infrastruktur di kawasan ini masih sangat terbatas, mereka yang berada di pulau Bunaken, Manado Tua dan Siladen begitu terbatas fasilitasnya. Sebagai pulau yang terkenal akan keindahan alam bawah laut, baik wisatawan nusantara bahkan wisatawan manca negara merasa belum ke Manado bila belum ke pulau ini, namun akses untuk ke daerah ini sangat terbatas dan hanya dikelola oleh pihak swasta dengan biaya yang relatif tinggi.

Dewasa ini Manado sudah tidak relevan lagi sebagai kota pelabuhan. Pelabuhan Manado yang dulunya disinggahi oleh kapal-kapal berbobot besar dengan rute antar propinsi bahkan luar negeri kini tinggal merupakan pelabuhan rute antar pulau dengan kapal-kapal kayu yang berbobot 500 DWT ke bawah. Adanya pelabuhan ini sebenarnya sangat mempengaruhi keberadaan dan pelestarian TNL Bunaken, karena dilihat dari jarak pelabuhan Manado ke Bunaken hanya 7 mil dengan waktu tempuh 30 menit menggunakan *speedboat.*

Melihat permasalahan di atas perlu dipikirkan pengalihan fungsi pelabuhan Manado menjadi pelabuhan khusus pariwisata. Pelabuhan ini diharapkan nantinya akan lebih menunjang pengembangan industri pariwisata Kota Manado. Pengalihan fungsi pelabuhan ini sekaligus dapat meminimalkan dampak lingkungan pesisir Teluk Manado khususnya TNL Bunaken yang menjadi kebanggaan masyarakat Kota Manado. Selanjutnya pelabuhan yang menangani rute antar pulau ini diusulkan untuk dialihkan ke pelabuhan Bitung mengingat jarak dari Manado ke Bitung hanya 45 Km.

3. Kawasan Permukiman

Perkembangan perekonomian kota yang semakin pesat telah mendorong berkembangnya usaha-usaha lain, terutama usaha di sektor swasta yaitu pada usaha perdagangan, pariwisata dan perumahan yang ditandai dengan bertambah pesatnya pembangunan fisik. Pertambahan tersebut mengakibatkan terjadinya permasalahan yang bersumber pada tumpang tindihnya berbagai

kegiatan kota, sehingga cenderung melampaui daya dukung lahan. Gejala *over-growth* tersebut memberikan dampak meruang dengan terbentuknya lingkungan padat penduduk dan bangunan dengan pola acak.

Dengan konsekuensi Kota Manado sebagai pusat pertumbuhan dan sebagai pusat pemerintahan, pelayanan kesehatan, dan pendidikan maka arus migrasi ke Manado sukar dibendung. Hal ini akan menimbulkan berbagai permasalahan dalam penggunaan prasarana dan sarana kota. Di sisi lain Kota Manado yang ingin menyandang predikat sebagai "Kota Pantai Nyiur Melambai abad 21" berusaha membenahi diri dengan mengatur keseimbangan pembangunan antar Bagian Wilayah Kota (BWK), ini dimaksudkan agar semua pelayanan kota tidak hanya terkonsentrasi di pusat kota saja.

Kawasan permukiman yang dulunya terkonsentrasi di pusat kota, dan terkotak-kotak menurut daerah asal penduduk, misalnya Kp. Tomohon, Kp. Kakas, Kp. Borgo, Kp. Arab, Kp. Cina dan lainnya, menjadi wilayah yang padat penduduk. Selanjutnya dengan bertambahnya penduduk dari waktu ke waktu dan adanya perluasan Kota Manado yang sebelumnya 2.369 ha menjadi 15.726 ha sejak dikeluarkannya PP No 22 tahun 1988, maka permukiman yang ada diarahkan ke utara, selatan dan timur Kota Manado. Permukiman ini berkembang sesuai dengan jalur jalan yang ada dan pada kemiringan 5 – 25% mengingat topografi wilayah Kota Manado yang bergelombang hingga berbukit (tidak seluruhnya bisa dimanfaatkan untuk kawasan permukiman).

Dewasa ini kawasan pesisir Teluk Manado diarahkan untuk kegiatan yang bersifat komersial, namun masih ada juga permukiman kumuh yang berada di tengah kota misalnya, permukiman Kp. Texas, permukiman Sindulang dan permukiman Titiwungen dekat Boulevard. Permukiman ini lebih didominasi oleh etnis Sangir dan Gorontalo yang mencoba beradu nasib di kota. Mereka datang biasanya hanya menumpang di rumah saudara/ teman sekampung ataupun mendirikan rumah darurat dan akhirnya hidup menetap dengan keadaan yang relatif tidak sesuai dengan persyaratan lingkungan.

Pihak Pemerintah Daerah telah berupaya melakukan perbaikan-perbaikan kampung melalui program P3KT dan lain-lain, namun hasilnya belum seperti yang diharapkan. Upaya lain dari pihak pemerintah untuk mengantisipasi kawasan kumuh ini antara lain dengan ditetapkannya jalur hijau (*green belt)* sepanjang Boulevard, namun semua ini belum bisa direalisasi sepenuhnya karena keterbatasan dana dan masalah teknis lainnya.

Melihat permasalahan di atas diharapkan Kota Manado sebagai kota pusat pemerintahan diharapkan mampu membenahi kawasan yang dinilai strategis dan mampu memberikan peluang ekonomi serta tetap memperhatikan keseimbangan lingkungan. Di samping itu perlu dipikirkan bagaimana upaya-upaya untuk memindahkan sebagian masyarakat di permukiman kumuh ataupun mendirikan rumah susun untuk mengantisipasi penambahan penduduk dari waktu ke waktu mengingat kebanyakan penduduk tersebut tidak memiliki Izin Mendirikan Bangunan (IMB).

4. Kawasan Konservasi

Kebijakan dasar pengembangan kawasan perencanaan dibagi atas dasar penetapan fungsi dan kebijaksanaan pengembangan struktur tata ruang. Pengembangan kawasan konservasi di Kota Manado sesuai RUTRK Manado 1990-2010 (1994) ditetapkan di BWK X (Wilayah Pengembangan Molas). Dilihat dari potensi dan kendala fisiknya, di daerah ini terdapat cukup banyak sungai dan adanya pegunungan (peg. Tumpa) serta perbukitan di sekitarnya yang membatasi pengembangan kawasan terbangun ke arah Timur. Pada BWK ini terdapat 3 (tiga) buah pulau sebagai Daerah Tujuan Wisata (DTW) di Sulawesi Utara, di sisi lain garis pantai dan hutan mangrove yang ada di sepanjang pantai Tg. Pisok desa Tongkaina dijadikan kawasan perlindungan/konservasi. Penggunaan lahan lainnya yang dominan di daerah ini adalah perkebunan kelapa, serta permukiman penduduk yang tersebar di sepanjang jalur jalan yang ada.

Adanya pertambahan penduduk dan penyebaran permukiman ke arah utara dalam hal ini di BWK X, akibat padatnya pusat kota dengan kegiatan komersial (perdagangan/jasa) diharapkan tidak memberikan dampak pada lahan yang sudah diperuntukkan sebagai kawasan lindung/konservasi. Selanjutnya kawasan pegunungan Tumpa yang berada di BWK ini ditetapkan sebagai daerah hutan lindung. Hal ini mengingat Kota Manado tidak lagi

memiliki hutan sebagai daerah penyerapan cadangan air untuk kegiatan Kota Manado. Penetapan kawasan Tg. Pisok sebagai daerah konservasi hutan mangrove dengan maksud antara lain: sebagai perangkap sedimen, sebagai tempat berpijah ikan/biota laut dan sebagai penyanggah kawasan TNL Bunaken.

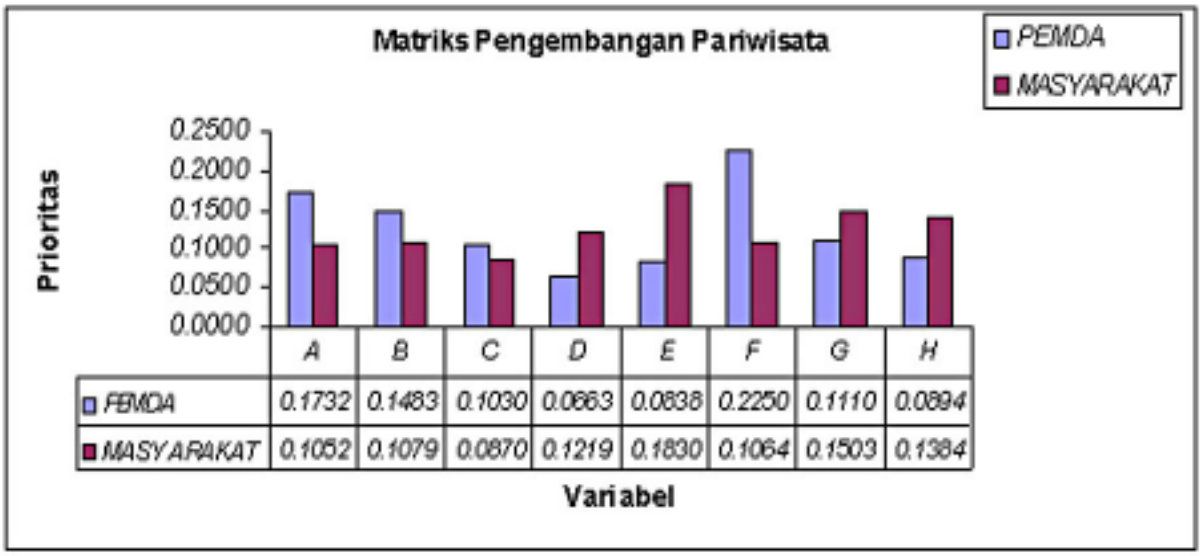
Dilihat dari fungsi di atas maka hutan mangrove ini diharapkan tetap dilestarikan. Untuk itu perlu adanya sosialisasi bagi masyarakat sekitar BWK X, agar masyarakat tidak menebang kayu sebagai diversifikasi mata pencaharian mereka. Selanjutnya diharapkan agar kawasan-kawasan yang ditetapkan dalam RUTRK Manado sebagai kawasan perlindungan/konservasi/jalur hijau dapat dikeluarkan peraturan daerah. Peraturan ini dimaksud untuk mengatur kebijakan yang ada, sehingga ada dasar kekuatan hukum serta dapat diterapkan sesuai dengan aturan yang berlaku.

Sebagai salah satu contoh yang konkrit mengapa perlu dikeluarkan peraturan, karena selama ini dalam menjalankan program pembangunan terlihat adanya ketidak konsistenan pihak Pemerintah Daerah dalam penetapan kawasan jalur hijau (*green belt*) di sepanjang jalan Boulevard. Sejak kawasan ini ditetapkan sebagai kawasan jalur hijau, maka beberapa tempat di Kecamatan Sario dilakukan pembebasan tanah, namun sayangnya di Kecamatan Wenangdengan adanya pihak investor (hotel Ritzi/Novotel) telah dikeluarkan IMB oleh dinas Tata Kota Manado, namun pembangunannya tidak mengikuti peraturan penetapan jalur hijau tersebut.

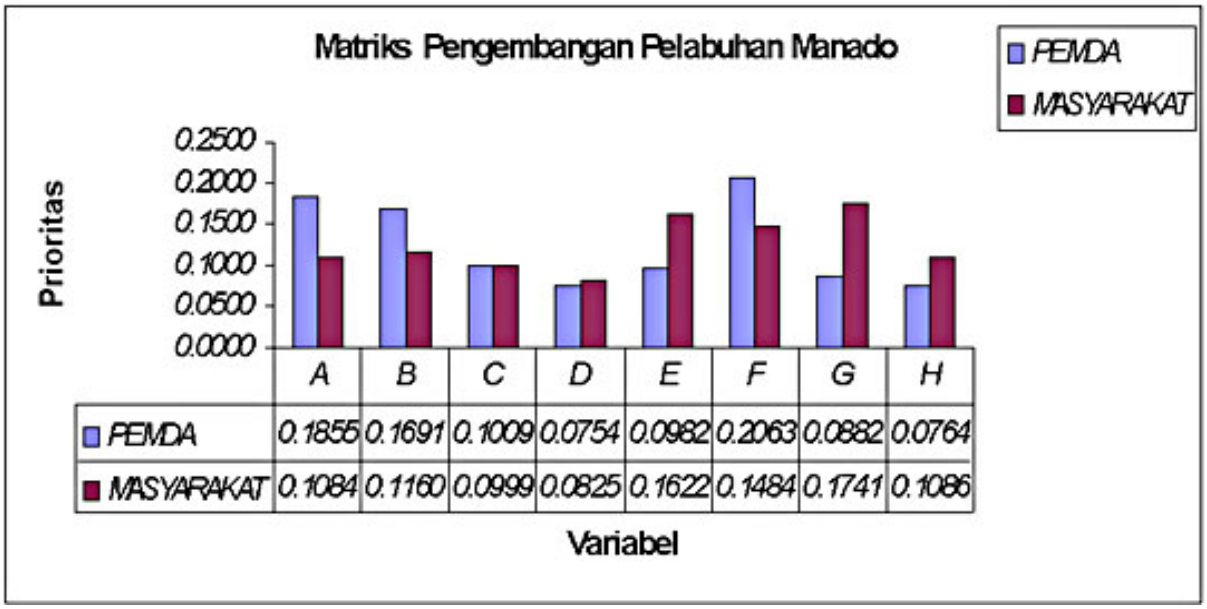
Analisis Konflik Pemanfaatan Ruang Kota

Dari hasil tumpang-susun antara RUTRK Manado 1990-2010 tahun 1994 dan pemanfaatan ruang saat ini, terlihat adanya penyimpangan dalam pemanfaatan ruang wilayah pesisir Teluk Manado. Penyimpangan pemanfaatan ruang ini dikaji lebih lanjut untuk mengetahui persepsi masing-masing s*takeholders,* agar dalam menggunakan ruang tidak terjadi konflik yang akhirnya dapat merugikan para pengguna ruang wilayah pesisir tersebut.

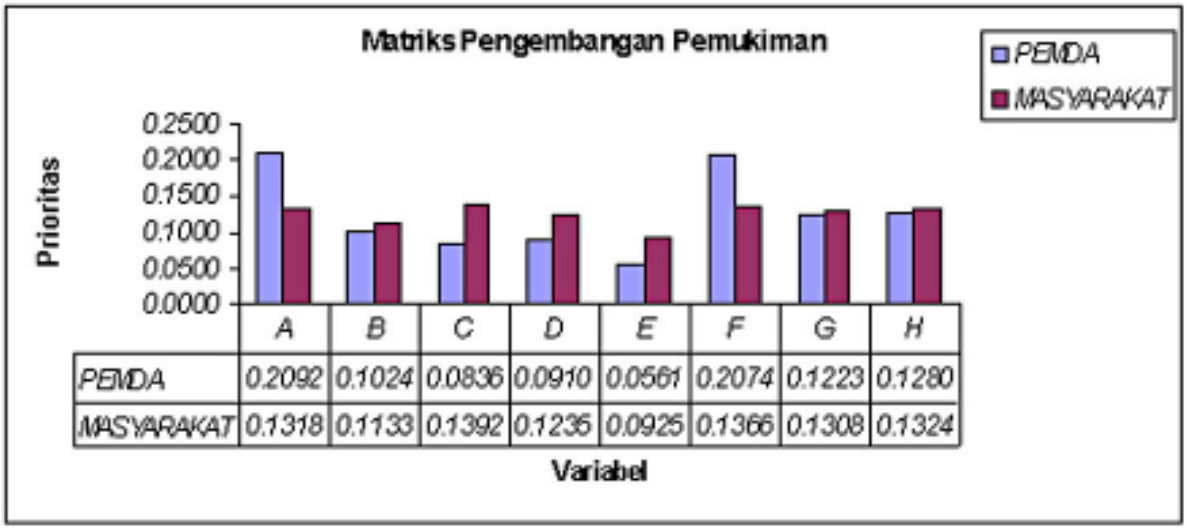
Dalam uraian pembahasan ini dilakukan dengan pendekatan Proses Hierarki Analitik (PHA). Pendekatan ini dilakukan dengan maksud untuk menangkap persepsi dari para pengguna ruang, baik pihak Pemerintah maupun oleh masyarakat pada umumnya, dimana variabel-variabel yang diamati diharapkan mampu mewakili kondisi, hambatan serta peluang yang ada dalam upaya pengembangan suatu kawasan untuk kegiatan pembangunan di wilayah pesisir Teluk Manado. Adapun variabel yang diamati dalam kajian ini menyangkut ketersediaan lahan, peraturan perundang-undangan, kesesuaian lahan, respon masyarakat, meningkatkan pendapatan masyarakat, sesuai dengan RUTRK Manado, pelestarian lingkungan serta dukungan masyarakat.



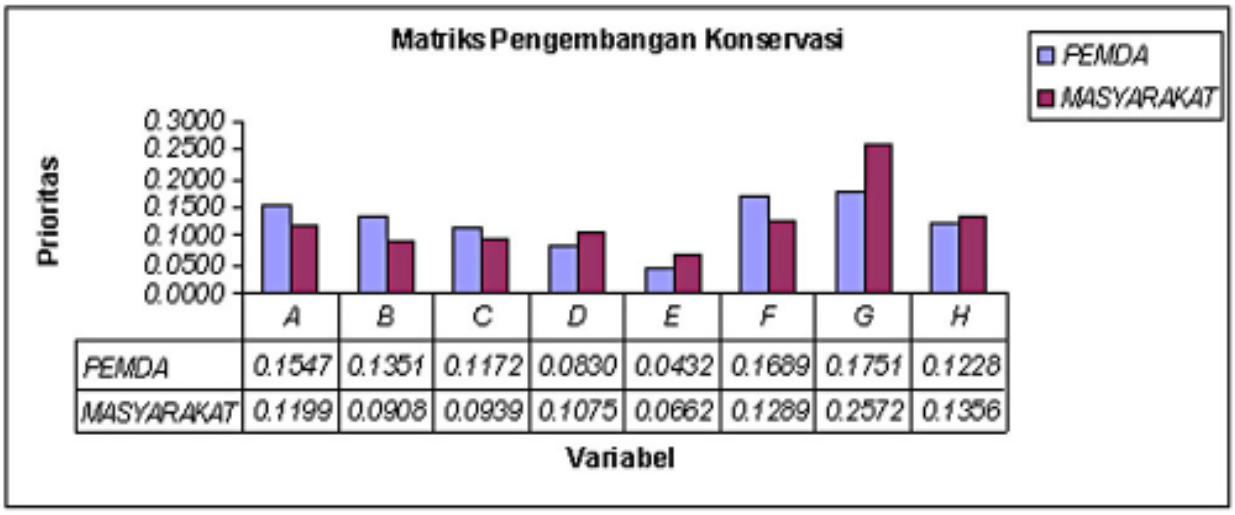
Gambar 8. Skala Prioritas Pengembangan Kawasan Pariwisata



Gambar 9. Skala Prioritas Pengembangan Kawasan Pelabuhan Manado



Gambar 10. Skala Prioritas Pengembangan Kawasan Pemukiman



Gambar 11. Skala Prioritas Pengembangan Kawasan Konservasi

Dari hasil angket yang diperoleh dari para pengguna ruang *(stakeholders*) dengan delapan kategori skala prioritasnya, dibagi lagi menjadi dua bagian, yaitu pihak Pemerintah Daerah sebagai aktor pengambil keputusan dan pihak masyarakat sebagai aktor pengguna ruang wilayah pesisir. Adapun hasilnya dapat dilihat pada Gambar 8–11.

Dengan melihat data di atas maka dalam pengembangan kawasan pariwisata pihak Pemerintah Daerah lebih mengutamakan variabel pendekatannya adalah Sesuai dengan RUTRK Manado dengan nilai prioritas adalah 0,2250, kemudian berturut-turut ketersediaan lahan 0,1732, Peraturan perundang-undangan 0,1483, Pelestarian lingkungan 0,1110, Kesesuaian lahan 0,1031, Dukungan masyarakat 0,0894, Meningkatkan pendapatan masyarakat 0,0838 serta Respon masyarakat 0,0663. Sedangkan pihak masyarakat lebih menekankan pada variabel Meningkatkan pendapatan masyarakat dengan nilai prioritas adalah 0,1830, kemudian berturut-turut Pelestarian lingkungan 0,1503, Dukungan masyarakat 0,1384, Respon masyarakat 0,1219, Peraturan perundang-undangan 0,1079, Sesuai RUTRK Manado 0,1064, Ketersediaan lahan 0,1052, Kesesuaian Lahan 0,0870.

Pengembangan kawasan pelabuhan Manado, pihak Pemerintah Daerah lebih menekankan pada Sesuai dengan RUTRK Manado dengan nilai prioritas adalah 0,2063, kemudian berturut-turut Ketersediaan Lahan 0,1855, Peraturan Perundang-undangan 0,1691, Kesesuaian lahan 0,1009, Meningkatkan pendapatan masyarakat 0,0982, Pelestarian lingkungan 0,0882, Dukungan masyarakat 0,0764, Respon masyarakat 0,0754. Sedangkan pihak masyarakat lebih mengutamakan Pelestarian lingkungan dengan nilai prioritasnya adalah 0,174 kemudian berturut-turut Meningkatkan pendapatan masyarakat 0,1622, Sesuai dangan RUTRK Manado 0,1484, Peraturan perundang-undangan 0,1160, Dukungan masyarakat 0,1086, Ketersediaan lahan 0,1084, Kesesuaian lahan 0,0999, Respon masyarakat 0,0825.

Pengembangan kawasan permukiman, pihak Pemerintah Daerah lebih menekankan pada Ketersediaan lahan dengan nilai prioritasnya adalah 0,2092, kemudian berturut-turut Sesuai dengan RUTRK Manado 0,2074, Dukungan masyarakat 0,1280, Pelestarian lingkungan 0,1223, Peraturan perundang-undangan 0,1024, Respon masyarakat 0,0910, Kesesuaian lahan 0,0836, Meningkatkan pendapatan masyarakat 0,0561. Sedangkan pihak masyarakat lebih mengutamakan Kesesuaian lahan dengan nilai prioritasnya adalah 0,1392, kemudian berturut-turut'Sesuai dengan RUTRK Manado 0,1366, Dukungan masyarakat 0,1324, Ketersediaan lahan 0.1318, Pelestarian lingkungan 0,1308, Respon masyarakat 0,1235, Peraturan perundang-undangan 0,1133, Meningkatkan pendapatan masyarakat 0,0925.

Pengembangan kawasan konservasi/jalur hijau/ hutan kota, pihak Pemerintah Daerah dan masyarakat sama-sama mengutamakan Pelestarian lingkungan dengan nilai prioritas masing masing adalah 0,1751 dan 0,2572. Sedangkan prioritas berikutnya pihak pemerintah memilih Sesuai dengan RUTRK Manado 0,1689, Ketersediaan lahan 0,1547, Peraturan perundang-undangan 0,1351, Dukungan masyarakat 0,1228, Kesesuaian lahan 0,1172, Respon masyarakat 0,0830, Meningkatkan pendapatan masyarakat 0,0432. Pihak masyarakat memilih Dukungan masyarakat 0,1356, Sesuai dengan RUTRK Manado 0,1289, Ketersediaan lahan 0,1199, Respon masyarakat 0,1075, Kesesuaian lahan 0,0939, Peraturan perundang-undangan 0,0908, Meningkatkan pendapatan masyarakat 0,0662.

Dengan melihat data skala prioritas di atas, maka pihak *stakeholders* mempunyai cara pandang yang berbeda mengenai pemanfaatan ruang wilayah pesisir Teluk Manado. Untuk mendapatkan alternatif pengembangan pemanfaatan ruang kawasan yang optimal, baik kawasan pariwisata dan pelabuhan Manado pihak Pemerintah Daerah lebih menekankan pada sesuai dengan RUTRK Manado, sedangkan untuk kawasan permukiman dan konservasi berada pada skala prioritas kedua setelah ketersediaan lahan dan pelestarian lingkungan. Dari hasil angket skala prioritas ini, keinginan pihak Pemerintah Daerah untuk menjalankan kebijakan yang ada sesuai dengan acuan/aturannya serta mengimplementasikan sesuai dengan kondisi yang ada di Kota Manado. Sayangnya, kenyataan di lapangan banyak program pembangunan yang dilakukan oleh Pemerintah Daerah, dalam hal ini instansi terkait lainnya, tidak sesuai dengan RUTRK Manado. Indikasi ini dapat terlihat dari RUTRK

yang dibuat oleh pihak Pemerintah Daerah, dalam hal ini Bappeda Kota Manado, tidak dijadikan acuan oleh instansi vertikal lainnya. Ini semua mengakibatkan pelaksanaan pembangunan atau implementasi program di Kota Manado berjalan sendiri-sendiri dan tidak terkoordinasi, misalnya:

a. Implementasi program/proyek yang ada di Manado dilakukan oleh banyak institusi dan sektor (mis. dinas, kanwil, perusahaan daerah, REI, individu pengusaha dan masyarakat) sehingga terkesan pihak Pemerintah Daerah Manado kurang memahami/mengevaluasi ruang lingkup kerja dan uraian tugas dari setiap organisasi/dinas yang ada dalam kewenangannya,
b. Pendanaan program/proyek yang ada selama ini didanai oleh berbagai sumber yang berbeda (APBN, APBD, Inpres, ADB, swasta, individu dan lainnya) sehingga kebijaksanaan peluncuran dan penyerapan dana dengan jadwal yang berbeda pula.
c. Hasil studi ataupun proyek penelitian yang dapat menunjang perencanaan, pelaksanaan maupun pengawasan pembangunan tidak terdokumentasi dalam satu *file* yang jelas dan sistematis.

Keadaan ini menjadikan pelaksanaan pembangunan di Kota Manado menjadi tumpang tindih, sehingga tidak dapat dilandasi pada skenario pembangunan yang jelas. Akibatnya kita tidak dapat mengetahui bagaimana pengaruh dari suatu pembangunan terhadap pembangunan lainnya, apakah akan saling menguntungkan ataupun akan saling menghambat dan mungkin yang lebih fatal lagi adalah mubazir.

Untuk mendapatkan alternatif pengembangan kawasan pariwisata, kawasan pelabuhan Manado, kawasan permukiman dan kawasan konservasi pihak masyarakat mempunyai persepsi yang berbeda pada setiap kawasan pengembangannya. Untuk pengembangan kawasan pariwisata pada kondisi sekarang ini lebih banyak mengutamakan meningkatkan harkat hidupnya dari segi ekonomi, agar hari esok lebih baik dari hari-hari sebelumnya, sehingga prioritas yang dipilih adalah meningkatkan pendapatan masyarakat. Selanjutnya untuk pengembangan kawasan pelabuhan Manado dan kawasan konservasi pihak masyarakat selalu mengutamakan pelestarian lingkungan agar tidak terjadi degradasi lingkungan pesisir Teluk Manado, sedangkan untuk pengembangan kawasan permukiman lebih ditekankan pada kesesuaian lahan. Hal ini sangat relevan dengan kondisi topografi Kota Manado yang bergelombang hingga berbukit. Luas kawasan terbangun Kota Manado berada pada areal yang sempit sehingga kecenderungan permukiman yang ada terkonsentarasi di pusat kota. Dengan melihat kenyataan ini perlu dipikirkan kawasan budidaya yang cocok untuk pengembangan kawasan permukiman, tanpa mengabaikan daya dukung lingkungan serta sesuai dengan kondisi topografi Kota Manado (tidak berada pada daerah yang rawan bencana).

KESIMPULAN DAN SARAN

Kesimpulan

Penggunaan lahan di Kota Manado didominasi oleh tanah pertanian/ perkebunan seluas 11.037,10 ha; kemudian berturut-turut perumahan seluas 3.598,83 ha; hutan seluas 662,70 ha; tanah jasa seluas 261,87 ha; tanah usaha seluas 190,63 ha; bandara seluas 169,44 ha; lokasi wisata seluas 114,11 ha; dan tanah kosong sudah diperuntukkan seluas 18,75 ha.

Hasil analisis peta penggunaan lahan aktual terhadap peta RUTRK Manado diperoleh:

- Adanya perubahan/penyimpangan pemanfaatan ruang yang ditetapkan dalam RUTRK Manado, baik untuk kawasan permukiman, maupun kawasan pariwisata dan kawasan konservasi, sedangkan kawasan pelabuhan Manado tidak mengalami perubahan penambahan ruang (sesuai RUTRK).
- Dari luas aktual kawasan permukiman yaitu 3.598,8 ha, yang konsisten dengan RUTRK seluas 1.667,2 ha sedangkan yang tidak konsisten dengan RUTRK seluas 1.931,6 ha; selanjutnya luas aktual kawasan pariwisata yaitu 114,1 ha, yang konsisten dengan RUTRK seluas 12,6 ha sedangkan yang tidak konsisten adalah seluas 101,5 ha; dan luas aktual kawasan konservasi yaitu 662,7 ha, yang konsisten dengan RUTRK seluas 559,3 ha sedangkan yang tidak konsisten seluas 103,4 ha.
- Dari peta kemampuan lahan Kota Manado, kemudian dimasukkan kriteria kesesuaian lahan, maka diperoleh pemanfaatan ruang yang sesuai untuk pengembangan kawasan adalah:
  - Pengembangan kawasan pariwisata berada

di BWK X (Wilayah Pengembangan Molas) yaitu: desa Tongkaina, Molas, Bunaken, BWK II (Wilayah Pengembangan Malalayang) yaitu: desa Malalayang I dan Malalayang II, serta BWK I (Wilayah Pengembangan Pusat Kota) yaitu: kelurahan Wenang Utara.

- Pengembangan kawasan pelabuhan manado yang berada di BWK I (Wilayah Pengembangan Pusat Kota) lebih ditekankan pada aspek peningkatan pelayanan dan pelestarian lingkungan karena areal ini tidak mengalami penambahan ruang.
- Pengembangan kawasan permukiman diarahkan ke Timur dan Selatan kota yaitu: Kecamatan Mapanget dan Kecamatan Malalayang. Hal ini dimaksudkan agar tidak terkonsentrasi hanya di Kecamatan Sario dan Kecamatan Wenang, sedangkan Kecamatan Molas diharapkan ada pembatasan luas areal ke arah ini mengingat wilayah ini ditetapkan sebagai wilayah konservasi dan pariwisata.
- Pengembangan kawasan konservasi/ruang terbuka hijau perlu mendapat perhatian khusus oleh pihak pengguna ruang mengingat adanya beberapa kawasan untuk kegiatan perlindungan setempat, telah dialih fungsikan menjadi kawasan budidaya lainnya (permukiman, lahan jasa, lokasi wisata dan lain-lain).

  a. Banyak faktor yang mempengaruhi terjadinya penyimpangan dalam pemanfaatan ruang kawasan pesisir Teluk Manado, diantaranya: (a) perkembangan kota yang sangat cepat dan dinamis seiring dengan potensi alam, masyarakat dan ekonomi yang sangat beragam, (b) masalah perencanaan serta implementasi dipecahkan dengan cara yang kurang tepat, akibat kurangnya koordinasi dan ketidak samaan persepsi di antara pengambil keputusan. Keadaan ini menjadikan pelaksanaan pembanguna kota menjadi tumpang tindih, tidak dilandasi pada skenario pembangunan yang jelas, sehingga tidak dapat diketahui bagaimana pengaruhnya terhadap pembangunan yang lain (apakah bersinergi, saling menghambat atau mubazir).

  b. Pada dasarnya pihak Pemerintah Daerah Kota Manado ingin menjalankan program pembangunan sesuai dengan acuan RUTRK Manado, namun adanya perubahan preferensi/prioritas, perkembangan kawasan-kawasan atau sektor yang tidak dipertimbangkan sebelumnya sehingga dalam implementasi terjadi perubahan kebijakan pemerintah/sektor untuk pembangunan skala besar sehingga tidak dapat ditampung oleh pola dan struktur ruang yang ada.

Saran

Mengingat adanya ketidak sesuaian atau penyimpangan antara wujud tata ruang yang ada dengan rencana penggunaan ruang, maka RUTRK Manado 1990-2010 perlu ditinjau kembali (direvisi). Revisi RUTRK ini meliputi: Wilayah Pengembangan Pusat Kota, Wilayah Pengembangan Malalayang, Wilayah Pengembangan Bahu, Wilayah Pengembangan Tuminting dan sebagian Wilayah Pengembangan Molas.

Sejalan dengan perkembangan kebijakan ini diharapkan RUTRK Manado 2000-2010 hasil revisi, dapat dijadikan produk hukum yang menjadi pedoman/acuan bagi landasan pembangunan Kota Manado dalam penyusunan Program Pembanguan Daerah periode berikutnya. Selanjutnya RUTRK hasil revisi ini harus dijadikan pedoman oleh instansi terkait lainnya (dinas dan lainnya) dalam menyusun program/proyek pembangunan yang terakumulasi melalui Rencana Detail Tata Ruang Kawasan (RDTRK). Selanjutnya RDTRK ini harus dijadikan acuan untuk penertiban perizinan lokasi pembangunan oleh pihak pengguna ruang lainnya serta pengawasan/ pengendalian pemanfaatan ruang masing-masing sektor pembangunan.

Diharapkan pihak Pemerintah Daerah Kota Manado dapat meninjau kembali izin bagi pemrakarsa reklamasi pantai Teluk Manado yang belum melaksanakan kegiatannya, sedangkan bagi pemrakarsa yang telah melaksanakan kegiatan perlu dilakukan pengawasan yang intensif, mengingat adanya dampak negatif akibat pelaksanaan pekerjaan tersebut, baik tahap konstruksi maupun tahap operasionalnya.

Mengingat beban intensitas pembangunan

terkonsentrasi di Teluk Manado, sudah saatnya pihak pemerintah daerah mengalih fungsikan pelabuhan Manado menjadi pelabuhan khusus pariwisata agar bisa memperkecil resiko degradasi sumberdaya alam yang ada di wilayah pesisir, khususnya TNL Bunaken, yang menjadi primadona Sulawesi Utara khususnya Kota Manado.

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CORALS, FISHERMEN AND TOURISTS

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ABSTRACT

As a result of natural and anthropogenic disturbances, coral reefs are endangered across the world. This paper addresses two anthropogenic activities, namely fishing and tourism, disturbing coral reefs. Although reefs are important in a global context for fisheries and tourism, more than 60% of all reefs worldwide are endangered by human activities. The use of explosives and poison for fishing has been banned since 1972. Nevertheless, up to 50% of small-scale fishermen use bombs and poison, at least temporarily. Both methods can cause long-term destruction of corals and reef structure, leaving behind only coral rubble, mile-long "coral cemeteries" whose skeletal dead corals are a sad reminder of the beautiful reefs before the destruction. On the Hong Kong market, the trade in ornamental fish for aquaria and live reef fish for consumption is worth more than 1 billion US$ annually.

Unmanaged tourism also destroys reefs in many ways - rapid coastal development that uses corals as building material, sedimentation, eutrophication and divers disturb coral reefs. This is also true for the increasing trade in souvenirs from the sea, where, as is the case for ornamental fish trade, the Philippines are the main export nation. In addition, natural disturbance factors such as climatically induced temperature variations or storms are frequently the final straw for already stressed reefs.

Fortunately, the number of marine parks and marine protected areas is increasing worldwide and several large international projects for reef protection and rehabilitation have begun. It remains to be seen whether decision-makers will discover that reefs, that are managed in an encompassing and sustainable manner, can provide economically viable returns. It must be realised that in order to achieve this, developing countries in the tropics must be substantially supported with true partnership projects.
Key words: Corals, tourism, fishing

ABSTRAK

Akibat gangguan alam dan manusia, di seluruh dunia terumbu karang berada pada kondisi yang terancam. Makalah ini membahas dua aktivitas manusia yang mengganggu ekosistem terumbu karang, yaitu penangkapan ikan dan pariwisata. Meskipun terumbu karang penting bagi aktivitas penangkapan ikan dan pariwisata, namun lebih dari 60 % terumbu karang dunia terancam akibat aktivitas manusia tersebut.

Walaupun penggunaan bahan peledak dan beracun dalam penangkapan ikan telah dilarang sejak tahun 1972, namun lebih kurang 50 % nelayan kecil masih menggunakan bom dan racun untuk menangkap ikan. Dua cara tersebut dapat mengakibatkan kerusakan jangka panjang pada struktur terumbu karang, sehingga yang tertinggal hanyalah "reruntuhan" terumbu karang dan bermil-mil "kuburan" terumbu karang. Di pasar Hongkong, penjualan ikan hias dan ikan karang hidup hampir mencapai US $ 1 milyar per tahun.

Pariwisata yang tidak terkelola ikut memberikan kontribusi dalam kehancuran terumbu karang melalui beberapa hal seperti: pengambilan karang untuk bahan bangunan, sedimentasi, eutrofikasi, dan penyelaman yang merusak terumbu karang. Hal lain adalah meningkatnya perdagangan souvenir yang berasal dari laut. Untuk hal ini Filipina merupakan negara pengekspor utama. Di samping gangguan manusia, faktor alam seperti temperatur yang bervariasi dan badai dapat juga menyebabkan terganggunya terumbu karang.

Untungnya, jumlah taman nasional di seluruh dunia dan proyek-proyek internasional guna melindungi terumbu karang dan merehabilitasinya mulai bertambah jumlahnya. Ini menjadi bukti bahwa dengan cara pengelolaan yang berkelanjutan terhadap sumberdaya alam, akan dapat dihasilkan keuntungan secara ekonomi. Hal ini harus disadari oleh negara-negara di daerah tropis guna mengadakan proyek-proyek kemitraan mengenai hal itu.
Kata Kunci: Karang, pariwisata, penangkapan ikan.

INTRODUCTION

Coral reefs are one of the most productive ecosystems on earth, although they usually occur in waters which are relatively low in nutrients. Reef ecosystems lying along tropical coasts are rich and indispensable sources of replenishing goods. Particularly for tropical countries, the function of coasts as a source for protein and foreign exchange is steadily increasing, because these countries are at the same time confronted, both with exploding growth of the coastal population, as well an alarming rate of coastal degradation. For these countries, sustainable use of reefs and other tropical marine ecosystems will soon be a question of survival.

Recently the press frequently reports that reefs are endangered worldwide (e.g. Der Spiegel 1999; National Geographic 1999), due to natural and anthropogenic reasons. This paper concentrates on two human reasons for reef destruction: fishermen and tourists, because they have been neglected in the past and public awareness is still low. Furthermore this paper concentrates regionally on examples from Southeast Asia and the Red Sea.

WHY DO WE NEED REEFS?

For fisherman coral reefs are a rich meadow, while for scuba divers and snorklers they are a pleasure for the eyes. But reefs have several additional important functions. They are indispensable and invaluable. Indispensable, because they protect coasts from erosion by waves and currents and because they make them safe[1] for navigation, fishing and tourism. They are also invaluable as effective coastal protection, because they re-grow and repair damage to a certain extent[2]. They also provide goods with a high value – worldwide reefs yielded ca. 375 $*10^9$ US$ per year (Costanza et al. 1997), of which 100 $*10^9$ US$ per year are for food from reefs or reef environments. In some developing countries food from reefs provides for 25% of the total food and 60% of the total protein intake.

Reefs are known for an enormous diversity of species. There are ca. 4000 species of fish and 800 species of coral described. It is estimated that about 9 $*10^6$ species occur in reefs, not counting the microbial species (Reaka-Kudla 1997). Therefore, reefs are a genetic treasure box. They host a number of bioactive substances, which are increasingly used in pharmacology and human medicine. They provide moulds for anti-cancer medication or raw material for implant surgery.

In spite of this global importance, reefs are endangered worldwide. According to a report by the World Resources Institute (Bryant et al. 1998), almost 60% of all reefs are endangered through human disturbance or activities, such as coastal development, overexploitation and destructive fishing methods, increasing sedimentation and eutrophication and pollution from domestic and industrial sewage. Climatic variations with abnormal high or low water temperatures (e.g. El Niño), as well as so-called "red-tides", toxic phytoplankton booms, are often the last straw for stressed reefs. In 1997 for example, in the International Year of the Reef and in 1998, the International Year of the Ocean, a worldwide bleaching of corals was observed (Wilkinson & Hodgson 1999). Almost 10% of all reefs were destroyed beyond repair.

The biggest negative influence on coral reefs can be very different from area to area. In Southeast Asia it is mainly sedimentation and destructive fishing practices, while in the Red Sea and the Caribbean tourism is the main factor. Consequently this paper presents the influence of fishing and tourism with selected examples from Indonesia, the Philippines and the Red Sea.

MISUSE OF REEFS

Coral reefs in Southeast Asia are known for their extraordinary species richness. As with rainforests, Southeast Asia represents the global centre for biodiversity, i.e. there are many species per unit area. For example some 400 reef-building corals, more than 3000 coral fish species and about 1700 species of molluscs are known from the region. Unfortunately the status of reefs in Southeast Asia is already critical, although they account for some 160,000 km^2, which corresponds to approximately 25% of all reefs worldwide. 35% of Asian reefs are considered disturbed and less than 5% are categorised as original or "excellent" (Cesar et al. 1997). Main reasons for this are overexploitation and unsustainable use, as well as rapidly increasing coastal development.

Fishing with destructive methods

Since 1972 the use of dynamite and various poisons for fishing has been banned in Indonesia. Nevertheless, up to 50% of fishermen at least sometimes use bombs and poison, although they are aware of the ban and realise that corals are destroyed (Kunzmann 1997).

Fishing with explosives can be done on different scales. Large bombs, target large areas, in order to catch baitfish for the longliners, who are after the highly sought and expensive tuna. Smaller bombs, on the other hand, catch reef fish for consumption to supply local fish markets and tourist restaurants. Both methods severely destroy corals and the reef structure. Only coral rubble remains, which is soon overgrown by algae, and organism in the vicinity of the explosion are killed or badly injured (Fig. 1-4). The recovery of human victims of self-made bombs can last months to years, while the recovery of reefs through resettlement with corals can take decades. In many cases the destruction is permanent.

Fig.1: Pulau Pandan, West Sumatra: destroyed reef crest in ca. 12 m depth. A big bomb of fishermen has left a crater of a diameter of 6 m, in the middle of a healthy reef, so that part of the reef has broken off and fell down the slope.

Cyanide and CN-insecticides are used in order to catch valuable ornamental fish for the lucrative aquarium trade.Expensive napoleon wrasses, groupers and crayfish are caught for the live-reef-fish export to Hongkong and Taiwan. These markets demand up to 25000 t live reef fish yearly, with a value of more than 1 $*10^9$ US$ (Johannes & Riepen 1995). Groupers, are traded for several hundred US$ each and a napoleon wrasse can fetch several thousand dollars (Lee & Sadovy 1998). For prestige reasons, rich Chinese businessmen are willing to pay up to US$ 2000 for a pair of napoleon wrasse lips! (Fig. 5).

The market share of the Philippines in the global export of ornamental fish is as much as 80%, the value is more than 100 $*10^6$ US$ per year. More than two thirds of ornamental fish are caught with cyanide, up to 75% of poisoned fish die upon capture. Another 60% of the survivors

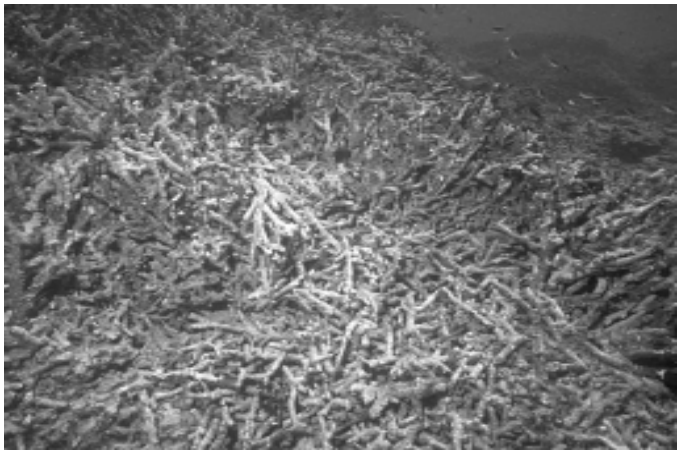

Fig.2: Pulau Pandan, West Sumatra: destroyed reef crest in ca. 7 m depth. Smaller, hand-made explosives have left crates of 1-2 m diamter. The resulting rubble of this Acropora formation are moved back and forth from the swell and work like a caterpillar, destroying large areas of the reef within the next two days..

Fig.3: Pulau Pandan, West Sumatra: destroyed reef crest in ca. 7 m depth. Photo taken seven days after Fig.2. Green, slimy algae overgrow the Acropora fragments, which prevents a resettlement by corals.

Fig.4: Pulau Pandan, West Sumatra: destroyed reef immediately under the surface. These Pachyseris specimens have been destroyed by a bomb, it looks like a cut with a sharp knife.

die during transport. The very same cyanides kill coral colonies in the vicinity as well as all small animals, like worms, gastropods, bivalves and crustaceans. Unfortunately fishing with poison is distributed all over Southeast Asia, the driving force up to now being an insatiable market (Johannes & Riepen 1995).

Aquarium fish can die even weeks after capture due to long-term, chronic damages from the poison, however the buyer does not know the real reason. As far as fish for consumption is concerned, very little is known about potential residues of the poison. Underwater, the long-term damage results in endless coral cemeteries, whose skeletons stand in growth position and give only a haunting clue about the beautiful reefs before fishing with poison.

The local fishermen receives only a very limited share of the above-mentioned sums, but for some additional income they is willing to take the small risk of being caught using poison. It is common that fishermen are protected by the navy or the fisheries authorities, because they easily accept bribes in return for "turning a blind eye".

Tourism

Tourism can damage reefs in many ways. Long coastal stretches are plastered with hotels, sewage is discharged straight into the sea and visitors pour by the hundred into the water either with various water-vehicles or by diving. Frequently hotels or the hotel roads are built with coral blocks, which have been cut out of the reef in front of the hotel. At the same time more and more tourists require larger airports, whose runways are even built on reef-tops (Fig. 6).

Those hotels, which have tried to save some hundred thousand dollars by using cheaper building material, have systematically destroyed reefs in front of their door. But more and more of them pay a large price. When the increasing coastal erosion due to the missing protective reef starts to reach and erode on the hotel walls, millions of dollars for artificial constructions to break waves must

Fig. 5: Head of a Napoleon Wrasse (*Cheilinus undulatus*). In top restaurants in Hongkong, prices up to 80 US$ per kg are accepted, for a pair of lips even up to 2000 US$.

Fig. 6: International Airport Bali: the runway has been extended by several hundred meters in the west, in order to provide for large aircraft like the 747. A beautiful reef, right in the tourist centre Kuta has been sacrificed.

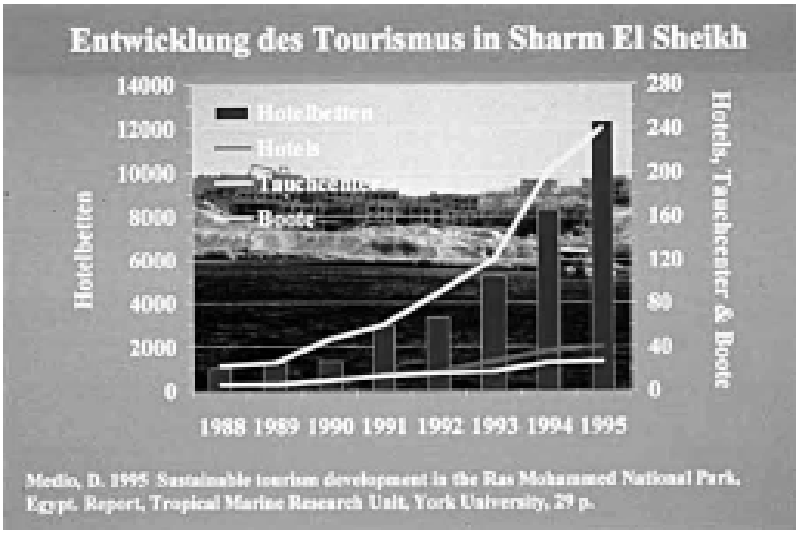

Fig. 7.: Development of tourism in the Red Sea area. The number of hotel beds and diving tourists has sharply increased since 1988.

be invested (Clark 1996). Furthermore tourists keen on snorkelling in unspoiled reefs, do not return.

Unfortunately tourism also supports a very lively trade of corals, bivalves and shells of gastropods. Thousands of tons a year are traded and the global market share of the Philippines is 90%. Among the shells one can find protected species like the tritons trumpet and the giant clam, which are, although in danger of extinction, traded illegally. Tropical shells also find their way to Germany to the booths on the beaches of North and Baltic Sea.

Growing tourism is also the driving force for rapid coastal development and for construction works on coasts worldwide (Caribbean and Southeast Asia), but particularly at the Red Sea. The increase in hotel beds and diving tourists in Fig. 7 is self-explanatory. In the Caribbean, where the total turnover in tourism is calculated at some 9 $*10^9$ US$ per year, tourism contributes 50% of the GNP in some countries. The Florida Keys for example had a gross turnover of 1.6 $*10^9$ US$ for the marine tourism in 1997 (Bryant et al. 1998).

Adventure holidays, often sold as "soft-tourism" and the diving business have a much stronger influence than has been previously assumed, according to three new studies from the Great Barrier Reef in Australia, the Red Sea and the Caribbean (Harriot et al. 1997; Hawkins & Roberts 1997). For example the number of divers is increasing steadily and therefore also the number of contacts of divers with corals (ca. 35-100 per dive), which harms corals. In the Red Sea more than 30% of all reefs are already negatively influenced. This is particularly true for Egypt, where plans are drawn up to intensify the marine tourism tenfold within the next five years!

There are more reasons, both natural and anthropogenic ones, why reefs are threatened, for example, by rapidly increasing sedimentation and eutrophication, which is caused through an unwise agriculture and forestry policy (Fig. 8). The number of disturbance factors increases and the intervals between individual disturbances become shorter and shorter so that even the strongest reef system does not have a chance to recover from injuries. Therefore, periodic occurring natural irregularities, e.g. ENSO in 1997/98 have such a catastrophic influence that reefs bleach and subsequently die on a global scale.

Fig. 8: Padang, West Sumatra: The dirty plumes of the rivers Kuranji and Banjir are clearly visible. After heavy rainfall they can be traced up to 15 km in front of the coastline, while the ingredients, like sediments and fertiliser from uncontrolled agriculture and forestry harm reefs.

WAYS OUT?

Fortunately the number of marine parks and marine protected areas (MPAs) have increased worldwide, also in developing countries. In Indonesia there are plans to double the area by 2005 (Kunzmann 1998). Large international programmes like the International Year of the Reef (IYOR 1997) or the International Year of the Ocean (IYO 1998) have contributed massively to increasing the awareness of local populations. Finally the large development banks have initiated several large projects for the protection and rehabilitation of marine systems, e.g. COREMAP, Coral Reef Rehabilitation and Monitoring Project in Indonesia, financially supported by the Worldbank AusAid, the Asian Development Bank and Japan.

As well as wise management of tourism, destructive fishing practices and coastal development have to be controlled very soon and should be subordinated under a concept of sustainable development of marine ecosystems. If not, coral reefs, source of income and food for millions of people will have little chance to survive. In order to achieve this, it is necessary to also make politicians, decision-makers and economic leaders aware of all potential commercial aspects of marine systems. Some of these are detailed in the following table:

Potential function of the reef	Potential yield per year and km^2 reef[3]
Coastal Protection	50 Mio. US$ (longevity of 100years[4])
Fisheries (10-30 t/km^2)	only 0.1 to 0.15 Mio. US$[5] (for 9 Mio. t/y = 12% of world catch)
Tourism	20 Mio. US$
Marine natural products/Pharmacology	? US$
Biodiversity/gene pool	? US$

FINAL REMARKS

The World Resources Institute report from 1998 summarises as follows:

- 58% of all reefs worldwide are endangered through anthropogenic influences
- In Southeast Asia, 80% of all reefs are negatively impacted
- Main factors are over-extensive and destructive use, as well as an increasing coastal development
- Globally there are more than 400 MPAs, but many are only on paper and about 150 are smaller than 1 km^2
- 40 countries with reefs do not have a single MPA

This analysis is a reason for concern. The sum of factors and their cumulative effects have destroyed many reefs beyond repair. There are still isolated reefs in excellent condition, for example in the South Pacific, which should be protected. It is therefore recommended to assist tropical countries by offering true partnership projects. Moreover we should no longer use short-term economic reasons as excuses not to implement partnership projects. Many times it has been discovered too late that this is short-sighted, because in the end there is a final bill we have to pay.

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1 Although reefs are usually known as obstacles for shipping, the leeward side of very long reefs, paralleling the coast, offers safe navigation, because waves are broken and swell is minimised (e.g. Indonesia).
2 This capacity for self-repair has natural limits, which are frequently overused by unwise exploitation.
3 Figures are from real projects in the Caribbean, Indonesia and Australia.
4 Wells & Hanna 1992
5 FAO 1996

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INTEGRATED COASTAL MANAGEMENT IN A DECENTRALIZED INDONESIA: HOW IT CAN WORK

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ABSTRACT

This paper describes the mechanics of establishing a voluntary, incentive-based integrated coastal management program in Indonesia that is consistent with the newly established laws relating to decentralization. It first offers a close analysis of those laws, specifically Act No. 22/1999 and its implementing Regulation No. 25/2000 regarding management authorities, and Act No. 25/1999 and its implementing Regulation 104/2000 regarding financial relations and financial management. The paper then discusses why these new laws increase the need for a vertically and horizontally integrated coastal resource management (ICRM) program in Indonesia. Lastly, the paper describes how a program can be developed under decentralization. The paper proposes a voluntary program in which the central government establishes standards and guidelines for developing provincial and district ICRM programs. In addition to developing standards, the central government would also put in place specific programs providing incentives available to provinces and districts that prepare a ICRM plans in accordance with these standards and guidelines. After coordination with relevant village and provincial governments, the districts, through the provincial government, would submit their plan for approval by the central government. Upon approval, the central government would provide technical and financial assistance, and as additional incentive, would commit to adhering to the regional plan itself. The paper further identifies sources of discretionary funding available to the central government to use for financing such a program.

Key words: Keywords: ICRM, Decentralization

ABSTRAK

Makalah ini menggambarkan mekanisme dari penyelenggaraan program Pengelolaan Sumberdaya Pesisir Secara Terpadu (PSPT) di Indonesia berkaitan diterbitkannya undang-undang otonomi daerah. Hal yang dibahas adalah UU 22/1999 serta peraturan pelaksanaannya menurut PP No. 25/2000 tentang wewenang pengelolaan, dan UU 25/1999 serta PP 104/2000 tentang pengelolaan keuangan dan pembagian pendapatan. Makalah ini juga membahas arti penting dari rejim PSPT terhadap pelaksanaan otonomi daerah. Hal lain yang juga dibahas adalah gambaran program yang dapat dikembangkan dalam bingkai otonomi daerah. Diungkapkan pula suatu program yang berkaitan dengan akan dipublikasikannya pedoman dan petunjuk bagi daerah oleh pemerintah pusat dalam menyusun rencana PSPT, sehingga jika Kabupaten/Kota akan melaksanakan berbagai macam peraturan tentunya harus mengacu pada pedoman dan petunjuk tersebut. Setelah melakukan koordinasi dengan pemerintah daerah dan propinsi, pemerintah kabupaten/kota, melalui pemerintah propinsi mengirimkan rencana pengelolaannya untuk disetujui oleh pemerintah pusat. Setelah disetujui, pemerintah pusat akan menyediakan bantuan teknis dan finansial. Lebih jauh makalah ini mengidentifikasi sumber-sumber pendanaan yang ada bagi pemerintah pusat untuk digunakan sebagai pembiayaan beberapa program pengelolaan tersebut.

Kata kunci: PSPT, Otonomi Daerah

REFORMASI AND DECENTRALIZATION

Even though Indonesia is the largest archipelago state in the world, with the second longest coastline behind Canada, integrated coastal resource management (ICRM) has only recently become a subject receiving any significant attention from the central government (Dahuri and Dutton, 2000). The government first addressed it in Repilita IV, in 1984, but it was not until 1994, in Repelita VI, that the national government considered the marine sector independent from other institutional and economic sectors (BAPPENAS, 1994). Since then, great strides have been made in promoting marine and coastal management issues, such as food security and fish production, hazards mitigation and control, land-based pollution and environmental protection of marine areas, within larger planning efforts. Progress to date is has largely been assisted by outside donor organizations, but received a tremendous boost from the central government itself with the creation of a new Ministry of Marine Affairs and Fisheries in 1999 - "DKP", 2001a). With this new ministry, there is now an opportunity for the development of a strong nationwide program for integrated coastal management (Kusumaatmadja 2000).

At the same time that these efforts are getting underway in the central government, the government reform movement (reformasi) has triggered a tremendous push to decentralization. Since independence in the 1945, and particularly since the New Order in 1965, Indonesia has operated under a centralized governance structure, with virtually all mandates emanating from the central government in Jakarta (MacAndrews, 1986). This regulatory structure is implemented through regional laws (Perdas) issued at the provincial level (enactments by the Governor and Provincial Parliaments or "DPRD I"), and regency level (enactments by the Regent, [or Bupati] and Regency Parliaments or "DPRD II").1 (Podger, 1994). With reformasi and the rise of democracy in Indonesia since the fall of President Soeharto in 1998, there has been a growing demand for transparency, honesty, and especially autonomy from the central government. The central government has responded with a series of laws shifting both the political power and the financial control from the central government to individual regencies, and enacting new legislation regarding corruption, collusion, and nepotism (Korupsi, Kolusi, Nepotisma). The result is nothing less than a revolution in governance

DECENTRALIZATION OF MANAGEMENT AUTHORITY

With the enactment of Act No. 22/1999 on regional autonomy and Act No. 25/1999 on financial relations in 1999, regional autonomy has become a fast reality. These two laws create the legal and financial framework for governance primarily by regencies, with assistance from both provincial and central levels of government (Alm and Bahl, 1999, Bell, 2001). Article 4 of Act No. 22/1999 sets the general tone, that the law is intended to arrange and organize local societies, through their own decisions, based on their own aspirations. Article 7(1) provides that the new authority for regencies covers every governance field except foreign affairs, defense and security, justice, finance and religion. However, the central government can issue regulations to withhold other areas of governance for itself. Article 7(2) provides that the central government also retains authority to develop policy regarding a host of subjects, including natural resource use and conservation. With respect to natural resources, Article 10(1) provides that the regional administration is authorized to manage available natural resources in its area, and is responsible for "maintaining environmental preservation pursuant to law."2

Act No. 22/1999 has tremendous bearing on coastal resources management. Most directly, Article 3 establishes a territorial sea under the jurisdiction of the province that extends up to 12 nautical miles from the coastal shoreline. Within this territory, Article 10(2) elaborates that provincial authority includes three categories: (a) exploration, exploitation, conservation, and management of the sea area; (b) administrative affairs; and (c) law enforcement. Pursuant to Article 10(3), the regency may establish jurisdiction over one-third of the provincial waters, seaward from the island shoreline, or 4 nautical miles from the coastal shoreline. However, there are two notable exceptions to this regional authority. First, the seabed underneath the sea territory is not explicitly included in the maritime area, so that authority for management of the seabed appears to remain under central government control

(although some regional governments are already establishing Perdas concerning mining of resources from the seabed, such as coral and sand). This includes rights to conduct activities on the seabed, such as oil, gas and mineral extraction. Second, the elucidation of Article 10(2) explicitly states that traditional fishing rights are not restricted by the regional territorial sea delimitation.

However, the authority for regencies is not absolute. According to Article 9, the province maintains authority in three circumstances: (1) cross-jurisdictional regency administration; (2) authority not yet, or not able to be, handled by the regency; and (3) administrative authority delegated from central government. Article 12 provides that Articles 7 and 9 shall be implemented through government regulations. Until such regulations are enacted, the parameters of this authority are unclear.

There is one principal regulation, however — Regulation No. 25/2000 - that fills in many of the gaps, clarifying the roles of the central and provincial governments in light of the authority delegated to the regency in Act No. 22/1999. Regulation No. 25/2000 provides that the authority of the national government generally relates to establishing policies, guidelines, criteria, and standards, and, supervision on a host of issues. The elucidation following Regulation No. 25/2000 defines these terms with language that clearly conveys that subsequent, more specific action is required. Thus the role of the central government is primarily one of indirect action rather than direct regulation and control, with specific action to follow at the regional level. However, the central government maintains the ability, pursuant to Article 7 of Regulation No. 25/2000, to take administrative action against a regional government that fails to implement existing laws or regulations.

Regulation 25/2000 states that with respect to the maritime areas within the jurisdiction of the central government, specifically within the Exclusive Economic Zone (EEZ) beyond the twelve mile mark out to two hundred nautical miles, the central government maintains direct responsibility for activities. The central government can determine conduct of exploration, conservation, processing and exploitation of natural resources in the waters outside the twelve miles (Art. 2(3)(2)(a)). Other responsibilities outside the 12 mile mark include law enforcement and regulation of waterways (Art. 2(3)).

The difference between the role of the central government generally and its role within its own jurisdictional territory is illustrated by the language in Regulation No. 25/2000 regarding natural resource conservation: Generally, the central government is to "determine guidelines on management and protection of natural resources" (Art. 2(4)(g)); but within its own jurisdiction, the central government is to "manage and to implement protection of natural resources in maritime areas beyond twelve miles" (Art. 2(4)(h)). The difference is thus one of developing guidelines for management by regional governmental entities, compared with management and implementation directly.

The role of the province is significantly more complicated and uncertain. Article 3 of Regulation No. 25/2000 reiterates the three circumstances in which the province maintains authority. Further, Article 3(5) provides that in virtually all sectors, any activity that involves multiple regencies is to be managed or authorized by the province. For example, the province is to manage environmental issues and water resources that cross two or more regencies, and to evaluate and analyze environmental impact assessments (AMDAL) for activities that involve more than one regency (Art. 3(5)(16)(a-d)).

As with central government authority in the EEZ beyond twelve nautical miles, Regulation No. 25/2000 gives the province clear autonomous authority within the territorial waters between four and twelve nautical miles. The regulation specifies that provincial authority includes the supervision of fishery resources and licensing of permits for cultivating and catching fish, and management of non-oil mineral and energy resources (Art. 3(5)(2)(a-e)).

If the province seeks to act in lieu of the regency, one of two conditions must be satisfied: (1) if the regency cannot have, or does not yet have, sufficient capacity, then the province can carry out the authority; or (2) if the regency decides, through mutual agreement with the province, then the authority is to be handled by the province. In either case, the authority must be transferred from the regency through a formal process. First, there must be a decision by the regent (bupati) and the governor, and this decision must

be approved by the respective DPRDs. The decision must then be reviewed by the Board of Consideration of Regional Autonomy within the central government, and be approved by the President. In the event of such transfer, implementation of the authority is to be funded from financial equilibrium funds transferred from central to regional governments. In the event that the regency declares its ability to handle such authorization, the province must return the authority to the regional government without necessarily obtaining the approval of the central government.

The provinces are the wildcard in the new decentralized regime. On the one hand, they have a minimal role in Indonesia's new power structure, with authority and funding almost completely bypassing them. Under Act No. 22/1999 and Regulation 25/2000, the provinces apparently have been largely cut out of any meaningful role of governance. Even were they to have one, under Act No. 25/1999, they have little financial means to carry it out with most financial resources, as with authority, flowing directly to the regencies. On the other hand, the provinces are not to be completely dismissed just yet. While Article 9 of Act No. 22/1999 limits their authority to three situations, these situations are presently very vague but potentially very broad. It is likely that the role of the provinces will be decided on a case-by-case basis, where strong governors may very well take advantage of the law's ambiguity and try to secure significant amounts of authority, while weaker governors will not be able to resist the general push towards district-level management.

DECENTRALIZATION OF FINANCIAL AUTHORITY

If Act No. 22/1999 is the vehicle for decentralization, then Act No. 25/1999 is the engine. It provides for an almost complete shift of budgetary management from the central government to regional governments. Article 1 of Act No. 25/1999 recognizes two basic budgets for governance: a central government budget for revenues and expenditures (APBN), and regional budgets for revenues and expenditures (APBD). Article 3 provides that regional revenue sources can consist of original revenues, loans, and equilization funds. According to Article 4, original revenues include taxes, retributions and revenues from regionally owned enterprises. According to Article 6, equilibrium funds consist of money derived from the APBN, and is divided into three components: (1) the region's portion of the proceeds from land and building tax, tax on land and building acquisitions, and proceeds from natural resource conversion; (2) general allocation funds; and (3) specific allocation funds (see Figure 1, end of paper).

With respect to the first component of the equilibrium fund, the central government gets 20 percent of natural resource revenues, specifically forestry, fishing and mining, while the regional governments get 80 percent (Art. 6(5)). From oil production, the central government gets 85 percent and the regional government gets 15 percent, and from natural gas production, the central government gets 70 percent and the regional government gets 30 percent (Art. 6(6)).

With respect to the second component of the equilibrium fund - the general allocation fund - the central government must provide the regional governments with at least 25 percent of the APBN (Art. 7(1)). Of this general allocation, 10 percent goes to the provinces and 90 percent to the regional governments. Article 7(3) provides that with any change in authority between the province and the regency, the percentage in funding levels must change accordingly (i.e., if transfer of authority is made between the two as described above). Article 7 also provides a formula for determining the share of individual provinces. This fund is the key mechnaism for attempting to balance and equalize funds among regions (Lewis, 2001).

With respect to the third component, — also from the APBN - specific allocation funds can go to help finance specific regional needs. This includes reforestation funds, of which 40 percent go to regional governments and 60 percent go to the central government (Art. 8(4)).

Act No. 25/1999 also provides, in Article 16, for a Contingency Fund (again from the APBN) for emergencies, which includes everything from natural disasters to shortfalls in regional funding. Until recently, much of the funding to the regencies has been distributed through this fund, rather than the manner otherwise provided in Act No. 25/1999, but as of July 1, 2001, the first disbursement from the General Allocation Fund was made to the regencies (GTZ, 2001).

Regulation No. 104, enacted in November 2000, elaborates on funding allocations in Articles 6, 7 and 8 of Act No. 25, specifically what revenues are subject to redistribution, what allocation exists between regencies and provinces, and what procedures are to be used to make the redistribution. Articles 9 and 10 of Regulation 104 relate to forestry and mining revenues, and provide that of the 80 percent revenues that go to regional governments, 16 percent go to the relevant provincial governments, while the remainder go to the regencies according to various distributions, with the bulk going to the particular regency in which the activity is taking place.

Article 11 of Regulation 104 relates to fisheries revenues. Section (1) defines these revenues to include levies on fishery exploitation and levies on fishery production. Section (2) states that these revenues "shall be distributed in equal sums to regencies throughout Indonesia." This is a fundamental difference compared with regional revenues from other natural resource uses, which are distributed primarily to the regency of origin. This difference highlights the fact that fisheries are treated as true commonly owned, national resources, to be shared by all. The result of this difference is that an individual regency will receive significantly less revenue from fishing activities within its own jurisdiction than other natural resource activities. This provision removes much of the pecuniary interest - and the immediate incentive — for regencies to sell off fishing rights, as they are already doing with concessions in the forestry sector.

In general, Act 25/1999 provides that the regencies will receive most of the public revenues. However, as much of the income is derived from natural resource use, the revenue distribution will vary enormously from region to region (Brown, 1999; U.S. Embassy, 1999). This disparity among regions is exacerbated by the fact that distributions of the general allocation fund are made independent of natural resource revenues (Lewis, 2001). More importantly, most of the income is to be used for administrative expenditures, such as operating new bureaucracies in the regions, and to support the transfer in each region of thousands of civil servants from central government rosters to the regional governments (GTZ, 2001). For example, in two regencies in central Java, it is estimated that upwards of 86 percent of the new funding will go to pay civil service salaries (MacClellan, 2001). Thus, very little new revenue will go to development projects and resource conservation.

While these four laws — Acts No. 22/1999 and 25/1999, and Regulations No. 25/2000 and 104/2000 — form the central pillars of decentralization, it is estimated that almost 1000 other regulations, decrees and guidelines will need to be modified and brought into line with these laws in an attempt to flesh out the meaning and process of decentralization. Even still, numerous questions remain as to the extent of central and provincial authority, and exactly how the authority is to be exercised in light of the decentralization emphasis on regency and authority (Bell, 2001). There is an effort by the central and provincial governments to revise the newly established system to restore some authority to themselves. For example, the DPR recently commissioned a study to revise Act No. 22, which recommended that regional jurisdiction over territorial seas within twelve miles of the coastal boundary baseline be revoked, with jurisdiction of those waters being returned to the central government (Hoissein, 2001). A new law to revise Act No. 22/1999 is currently being drafted, and is expected to be completed for review by the DPR sometime before the end of the year.

THE NEED FOR AN INTEGRATED COASTAL MANAGEMENT PROGRAM

The existing legal regime governing resources in Indonesia is, in a word, sectoral, meaning that they are not managed as a whole, but as individual elements. There are approximately 20 Acts that relate to coastal resource management in particular (Putra, 2001). These Acts can be loosely grouped into six categories. Marine spatial laws relate to geographic delimitations of the ocean, and jurisdictional control over the maritime zone. Marine sectoral laws relate to sectoral uses of ocean resources. Terrestrial spatial laws relate to general planning aspects on the land, as well as jurisdictional issues regarding land management. Terrestrial sectoral laws constitute the bulk of laws relating to coastal resource management. These include laws relating to terrestrial economic and social sectors, but that affect the sea. In recent years, environmental legislation has sprung up relating to environmental pro-

tection and natural resource conservation, including: Act No. 5/1990 concerning Living Resource Conservation and Preservation; Act No. 5/1994 ratifying the Biodiversity Convention; and Act No. 23/1997 concerning Environmental Management. These laws are not sectoral, because they do not govern any one sector. Rather, they form a substantive and procedural overlay for all other sectors, and their requirements must be satisfied in the conduct of all activities. Finally, there is the legislation relating to decentralization, which also forms an overlay to all other laws.

There are generally three reasons for the profound number of conflicts, gaps and overlaps in Indonesian law. First, Indonesian laws themselves are so vague and broad that conflicts often arise even within a single Act (i.e., one Act may offer two or more broad goals or principles that, when applied in specific circumstances, may conflict). For example, in Act No. 9/1985 relating to Fisheries, Article 7(1) prohibits damage to the marine habitat, yet the Act also allows bottom trawl fishing and other capture fishing gear types that, depending on the situation, can be very destructive to surrounding habitat. Second, the rules of statutory construction for resolving differences among laws are vague and broad. As in most countries, Indonesia recognizes the premise that laws enacted later in time take priority over laws enacted earlier in time, and laws that are more specific take priority over more general laws. These rules of legal interpretation are not codified, however, so there is no consistent application by the judiciary (Diantha, 2001).

Furthermore, the rule of interpretation that is codified in a typical Act is extremely weak: each Act states that previous laws remain valid unless specifically in conflict with the new Act. Rather than explicitly replacing one law for another, the Act offers only an implicit replacement. Such an implied repeal is often very difficult to interpret. Third, where conflicts do arise, they are generally not resolved through the judiciary. Rather, they historically have been resolved with the issuance of a Presidential Decree or Ministerial Decree. This approach - where the executive branch of government resolves disputes among laws enacted by the legislature - makes a highly politicized legal system with little certainty, as opposed to an approach in which the judiciary resolves disputes and adheres to its own precedents. (Heydir, 1984).

These conflicts are exacerbated in coastal management issues because coastal management involves a particular bio-geographic space (i.e., the coastal area) in which many sectors operate rather than focusing on activities within a particular sector (Purwaka, 1995; Putra, 2001). For example, there are conflicts and overlaps in definitions of terms among different Acts, particularly terms that define protected areas. Many of these defined areas appear almost identical in purpose, and yet they have different classifications under different laws, which give rise to different uses.3 As one example of a conflict between marine and forestry sectors, Act No. 41/1999 relating to Forestry allows for harvest of coastal mangrove forests; however, such harvest conflicts with the prohibitions against damaging habitat of fishery resources, contained in Article 7(1) of Act No. 9/1985 relating to Fisheries. As another example of conflict between the fisheries and natural resources sectors, Act No. 9/1985 has an extremely broad definition of the term "fish" that can be harvested under that law, including sea turtles, marine mammals such as whales and manatees, sea cucumber and corals; however, Act 5/1990 relating to Conservation of Natural Resources protects fish and wildlife that are threatened with extinction.

Conflicts are also exacerbated with respect to enforcement. Different Acts have different sanctions and liability for similar offenses. Sanctions, such as criminal versus civil penalties, vary widely. Different Acts also have different standards of liability, such as negligence, intentional or strict, for almost identical violations. This complicates enforcement and prosecution efforts. There are countless other examples, especially in looking at regulations and decrees. There is a profound need to develop a new umbrella law that serves to coordinate existing laws and create new mechanisms to resolve legal discrepancies. This is the primary reason why a new nationwide coastal management program is necessary.

A second reason is to support and increase the growing number of community-based coastal conservation projects currently underway in Indonesia. Since the mid-1990s, there has been a

growing realization that greater autonomy and community-based governance was likely to be more effective in protecting the environment (CIDE, 1995; White et al. 1994). Since then, numerous projects have been carried out in Indonesia that support community-based management of natural resources, with good success (Dutton et al. 2001). Particularly in the marine and coastal sector, projects in the last 10 years have, at the local level, raised awareness, developed capacity and skills for resource management, and established conservation areas (Sofa, 2000). There is a desire among the central government and other groups to establish a national mechanism to replicate such projects (Crawford and Tulungen, 1999).

A third, related reason is to provide formal guidance to regional governments and communities that now have authority to manage their coastal resources, but as of yet do not have the ability or experience to do it themselves. This guidance would draw heavily from the community-based models that already exist, and shape new models for the future (Crawford, et al. 1998). While regional differences must be accommodated, there are still several basic principles that are relevant in all regions (Cicin-Sain and Knecht, 1998). These include the establishment of an ongoing, adaptive process for resource management specifically addressing coordination, collaboration or integration among both (i) different activities that affect the coast, its resources and its inhabitants, and (ii) different groups within society involved in, or affected by those activities. In addition, a synthesis of conservation and use of coastal resources must be achieved for the benefit of present and future generations dependent on these resources. There are also certain methodologies that apply generally in coastal resource management, regardless of regional differences (Clark, 1996). There is a great need to convey these principles and methodologies to the regions through national guidance and direction before unrepairable damage or loss of these coastal resources occurs.

DEVELOPING A NEW INTEGRATED COASTAL MANAGEMENT PROGRAM IN A DECENTRALIZED INDONESIA

An integrated, decentralized coastal resource management program can fit comfortably into Indonesia's new governance structure and is needed to ensure alignment of budgets with appropriate priorities (Knight, 2000). The general framework entails promulgation of national guidelines and standards to be implemented at the regional level, which is exactly the vision behind Law No. 22/1999 and Law No. 25/1999. This section addresses four overarching questions: (1) how would the central government implement the program (in particular, should it create a mandatory or voluntary program)? (2) how would the regional government implement the program? (3) what potential incentives are available to support implementation of the program? (4) how would the program be funded?

THE ROLE OF THE CENTRAL GOVERNMENT

The new role of the central government under Act No. 22/1999 and its regulations is to develop guidelines and policies rather than directly control and manage activities. Specifically, the central government can establish policies and guidance under Article 7(2) of Act No. 22/1999, and can enforce laws and regulations under Article 7 of Regulation No. 25/2000. The question arises as to the nature and consequence of these guidelines and policies. Can it require adherence to these guidelines and policies if management authority rests with the regencies? Even if it has authority to require such adherence, can it, as a practical matter, enforce such adherence? While the answer to the first question is yes, the answer to the second question is likely no. First, with implementation of policy now at the regional level, policy emanating from the national level may increasingly have little meaning or respect in the regions. Second, with budgetary and financial matters now being exercised almost completely at the regional level, national policy is likely to be given even less attention in regional government decision making and budget allocations. Third, any national policy necessarily must be broad and general enough to cover regional differences, thus creating lots of room for differing interpretations of the policy and thereby making any effort at consistent enforcement extremely difficult.

Consequently, it makes sense to look at

whether new national programs, such as for ICRM, should be voluntary in nature. A voluntary program would avoid the obvious questions about the extent of central government authority in enacting and enforcing a mandatory program. First, even though a mandatory program may seem to be the stronger alternative, if implementation is not likely to follow at the local level, and enforcement is not likely to come from the national level, then a voluntary program obviously would be more effective. Second, a voluntary program would be acceptable to the community implementing it - by its nature as a voluntary program — so it would stand a better chance of being implemented and enforced by the communities which are closest to the resources. This is already demonstrated with the community-based projects in Northern Sulawesi, in which villages have adopted coastal management ordinances that they themselves drafted. In terms of enforcement, these village level ordinances include penalties for those violating these coastal management ordinances that have already been used to enforce inter-village violations.

A voluntary program would also allow the regional and central governments to effectively transcend the confines of Act No. 22/1999 and Regulation No. 25, because those laws recognize such mutually agreeable arrangements. Specifically, Article 3(d) and Article 4 of Regulation No. 25/2000 provide the flexibility. Article 3(d) provides the general authority for delegation agreements. Article 4(a) states more specifically that the regencies can delegate any portion of their authority to the province; under section (i), the provinces can delegate any portion of their authority to the central government; and under section (j), the central government or province can redelegate the authority. Thus, a voluntary arrangement would allow the various levels of government to delegate different responsibilities and activities among each other based on their respective strengths and weaknesses. See Figure 2, end of paper.

The question then becomes how to encourage voluntary implementation in line with guidance issued from the central government. The answer lies in the central government's ability to craft a package of incentives that would entice provincial and district level governments to adopt and implement an ICRM program. This package would include financial and technical assistance, in the form of grants and loans, advice and guidance, training and outreach, which is consistent with the role of the central government as envisioned in Act No. 22/1999 and its regulations.

The central government could offer additional incentives: for example, the central government could agree that its own activities must comply with the provisions of any regency ICRM program if that program is certified in compliance a national ICRM law and guidelines promulgated by the central government. This type of compliance is not required under Act No. 22, particularly for areas of governance enumerated in Article 7. However, as incentive for regencies (and provinces) to adopt ICRM programs, the central government can commit to this approach. For example, if a regency were to develop and receive national certification of its ICRM program consistent with the requirements of the central government law, then future activities by the central government, especially those relating to economic development, infrastructure development, and natural resource management in the coastal area, would be required to be consistent with the regency ICRM program. In such a case, a finding of compliance from the regency (or province) would be required prior to the central government initiating activities. Such an arrangement also furthers the spirit of decentralization, providing even greater deference to local governments than required under Act No. 22/1999.

However, such benefits and incentives should not be given to regional governments without any strings. There must be some standards and criteria that they must follow in order to ensure that they develop and implement an ICRM program that deserves those benefits. Article 2(3)(2)(d) of Regulation 25/2000 specifically recognizes that the central government has authority to set standards for management of the coasts. In this case, the central government must develop minimal requirements with which the local governments need to comply in order to receive any benefits. These would include obligations imposed by international treaties to which Indonesia is a party, and requirements that are in the public interest. Authority for these requirements stems from not only the general provisions of Article 7 of Act No. 22/1999, but also the provisions relating to central government supervi-

sion in Articles 112-114 of Act No. 22/1999. These articles state that the central ogvernment should foster and supervise implementation of decentralization by providing manuals and regulations. Regional governments are required to submit newly enacted Perdas to the central government, which is authorized to cancel the regulations if they contravene the public interest or other higher laws.

The central government should exercise this authority in three instances. First are minimal general environmental and public health requirements on activities affecting coastal resources and populations. Among others, this includes such standards as wastewater treatment and discharge requirements, solid waste disposal, pesticide and herbicide use, and extraction of renewable coastal resources such as fishing quotas and mangrove harvest yields etc. As in other countries, regional governments would be open to set more stringent standards but must at least meet these national standards protecting public health and general environmental protection.

Second, it should include basic substantive requirements for coastal development. This includes spatial planning and land-use requirements specifically for coastal areas,, issuing standards for spatial planning, mandating priorities for coastal-dependent uses, and identification of areas for special management actions, environmental protection or hazards control.

Third, it should impose procedural requirements to ensure coordination and transparency, such as interagency review coordination, development permit review processes, mandatory public participation and stakeholder involvement, transparent dispute resolution procedures, and other requirements all focused on pushing control of coastal management decision making to the lowest level possible (i.e., to the level of coastal residents and resource users).

The central government would provide assistance to local governments to develop ICRM plans that meet these requirements, formally approve those plans that satisfy them, and provide the incentives and benefis to any regional government with an approved plan. Within the ICRM plan development process regional governments would have broad latitude to develop plans that suit specific local needs. While process and general public welfare standards would be in place through the national law and national guidance, regional governments would decide on appropriate coastal resource management approaches based on locally held public values and aspirations. The central government would then monitor and review implementation of such plans to ensure they are faithfully carried out consistent with the intent of the national program and to verify continued entitlement to incentives provided through the central government.

As an example, for ICRM planning purposes, regional governments would define the boundaries of the 'çoastal area' covered under the ICRM plan, particularly the landward boundary, in a way that suits their particular needs. This will allow each regency or provincial government, through an open and participative process, to address the tremendous range of biophysical and ecological differences seen from region to region. Boundaries for the coastal area could be defined in a number of different ways based on these variations, ranging from narrow political, or otherwise arbitrary boundaries, to broad ecosystem-based boundaries covering large inland areas (Suominen, 1994). At the same time, the central government should provide minimum standards and guidelines to regions in defining the coastal area. For example, a minimum standard might require all regional definitions to include ecological criteria, or might allow regional governments to define the coastal area using political boundaries such as the limits of the territorial sea of a certain distance. Minimum standard guidelines would include a broad discussion of the methodologies such as these for determining the extent of coastal areas covered by ICRM plans as well as other elements important to planning such as use of GIS or scales of maps.

The next question is how the central government would establish and implement such a program. The key to ICRM is the development of a procedural mechanism for coordinating management and ensuring appropriate budgetary decisions. The most obvious mechanism is the establishment of an interagency council with adequate authority delegated from the sectoral agencies. Although still very early, the process for identifying a coordinating structure at the national level has already begun with the recent establishment of the Ministry of

Marine Affairs and Fisheries and the National Maritime Council. The DKP is currently leading the development of the Academic Draft (formal supporting documentation required for all new proposed legislation) report in support of a new national act to be prepared (DKP, 2001). Also, DKP recently initiated interdepartmental meetings to begin raising the awareness of other ministries of the potential of a national program and to explore how coordination might be accomplished.

However, coordination of a successful ICRM program must have a mechanism to elevate unresolved issues to a body higher than any individual sectoral ministry, including DKP. For example, if the members of a coordinating body cannot resolve a conflict, the conflict should be handled by a Coordinating Minister, or perhaps more appropriately, the President. While other models exist, the important point is that successful implementation of a national ICRM program must involve an interdepartmental coordinating body with a dispute resolution mechanism.

THE ROLE OF REGENCY GOVERNMENTS

The big winners under Act No. 22/1999 and its regulations are the regencies. Except for the few areas of governance withheld under Act. No. 22, they essentially have authority for all decision-making within their jurisdiction, unless otherwise stipulated by central government regulation, or in certain circumstances in which the province has been given authority. Unless issues of national interest are violated, regencies can certainly manage coastal resources as they see fit, independent of any national program. However, a national program can provide guidance and assistance that they otherwise will not have at their disposal. In fact, it is expecetd that some regencies would initiate a program independent of the central government guidance, although if properly designed, the incentives available for a national program should achieve widespread participation.

Compared with central and provincial governments, regencies are best positioned to develop ICRM programs tailored to local contexts, resource supplies and public aspirations and values. Regencies are close enough to the resources and its users at the local level, and yet it still large enough to coordinate among neighboring villages. It is incumbent that any ICRM program developed at broader levels of government provide for meaningful participation down to the most local level. However, through sub-regency (kecematen) offices, the regencies generally have strong connections with village and sub-village governing bodies. In general, development of all ICRM plans must be done in close cooperation between regency and village governing bodies, and include all stakeholders, public and private.

The regency would be responsible for first deciding whether it wanted to engage in an ICRM program sponsored by the central government. Once an individual regency made the decision to develop an ICRM program, the central government could provide financial grants and technical assistance for the endeavor Development of the ICRM program would follow the requirements laid out in the central government guidance and be done in cooperation with the provincial and central levels of government, as well as constituents and stakeholders within the regency. Once completed and approved, the regency ICRM program (through specific activities) should be carried out by not only the regency, but by kecematen and desa levels as well. The regency program would provide for "nested" ICRM action plans at these levels, which would allow for plans that and again, more closely reflect public values and aspirations within individual communities. The development of village level ICRM plans in North Sulawesi stands as a good example where villages have initiated local plans that are now being legally recognized by Minahasa Regency government.

Within the framework established by the central government, regencies also would develop the necessary procedural mechanisms for coordination and collaboration, similar to cross-sectoral coordination established at the central government level, and would ensure that the necessary substantive requirements outlined in the national guidance are satisfied. Beyond satisfying those minimal requirements, regencies would have flexibility to structure ICRM plans in whatever way best met local needs and conditions, and to use whatever mechanisms judged locally appropriate to satisfy the broader goals and objectives of the national ICRM program. In this way, a voluntary national ICRM program is

in line with the intent of regional autonomy provided through Act No. 22/1999 and its implementing regulations.

While the regency is the most logical level for management of coastal resources, it might not be the most logical level for coordination with the central government. Of 332 regencies, 245 have a coastline. While not all regencies would be expected to take part in a voluntary ICRM program, it is to be hoped that most would. In any event, the number can potentially be huge, which would create a tremendous logistical challenge for the central government in assisting, approving, and monitoring eachindividual ICRM program. At least in terms of regency-level ICRM programs, provincial governments may have a potentially important role.

THE ROLE OF THE PROVINCES

The role of the provinces would need to be defined explicitly, as their authority under the regional autonomy laws is ambiguous. For example, provinces have authority to manage cross-jurisdictional issues involving multiple regencies. It will be hard to find an issue in natural resource management that does not cross the jurisdiction of more than one regency. This is especially true in coastal resources management where marine resources are highly mobile (as is pollution) and where there is often a strong connection between terrestrial activities and impacts to coastal water quality and resources. Even within the four mile sea territory under jurisdiction of the regencies, provinces could argue that they can manage activities that affect other regency waters. Consequently, provinces could conceivably seek to assume much of coastal resource management themselves. In addition, provinces can assume authority for activities over which regencies do not yet have, or cannot have, capacity to manage. This again can be seen to be extremely broad. However, the process for transfer of authority requires the agreement of the regency, which may have a different opinion as to available capacity. Consequently, this provision may be used rarely.

Regardless of the authority that the province can attain for itself, actually enjoying that authority may prove difficult, since it has relatively little additional funding under Act No. 25/1999. The distribution of revenues, particularly revenues derived from natural resource consumption, is going to play out between the central government and the regencies. As a result, the role of the provinces will, almost as a matter of default, take on a tone of guidance and policy, rather than actual management (Kaimudin, 2000). On cross-boundary issues, they may have a stronger hand in shaping policies, coordinating activities, and settling disputes, but it is doubtful it will amount to more than that.

Such a role for the provinces would be consistent with an ICRM program. Indeed, this is the type of role that should be explicitly delineated for provinces. Specifically, they would assume three responsibilities., each perfectly valid under Act No. 22. First, the province could prepare guidelines and standards to elaborate upon the central government guidelines. Given the breadth and generality of guidelines and standards that will come from the central government, more specific guidelines and standards from the provincial government could prove very useful. The differences among provinces that must be addressed in ICRM are enormous. There is a great difference among provinces in information access, resource wealth, industrial and manufacturing base, and urban and rural development. These differences can be more adequately addressed at the provincial level than at the central level. Second, provinces could review regency plans and package them to facilitate central government approval of them. Even if provinces do not have formal control over regency decision-making, they could play important roles in facilitating and coordinating review of regency plans by the central government. Provinces could also make recommendations both to local and central governments as to improvements to the plans in terms of local conditions or broader inter-regency, inter-province or inter-sectoral coordination. Third, provinces could serve as the liaison or middleman for technical assistance to help implement the ICRM programs at the local levels.

In addition to these general responsibilities, the province can, with agreement of the regency, manage coastal resources either in lieu of the regency or jointly with the regency. In the event that

a regency does not have adequate authority for coastal resource management, the national program can provide - as a stipulation for certification and receipt of financial assistance - that the regency allow the province to assist it in its responsibilities. Such an arrangement would be an innovative but powerful use of the delegation authority under Articles 3 and 4 of Regulation No. 25/2000.

FUNDING AN ICRM PROGRAM

As mentioned earlier, a voluntary ICRM program must be based on a package of incentives that will encourage participation by the regions. This requires, above all else, funding. Regencies will already receive significant new funding pursuant to Act No. 25/1999. Currently, it is expected that most of this funding will be devoted to administrative expenditures. As a result, additional funding, from either the central government or provincial government, would provide opportunities to engage in management and conservation activities and would provide an incentive for regencies/cities to engage in an ICRM program. The question, of course, is where the central and provincial governments would get the funding. There are several possibilities.

The most straightfoward possibility is that the central government, most likely DKP, dedicates a portion of its budget for grants for ICRM program development and implementation. In addition to grants, the central government can use its own funds to establish a revolving loan fund for projects. However, given the lack of funding at the central government level, particularly as Act No. 25/1999 gets implemented more consistently in the future, there is likely to be only relatively small amounts available and this may not provide adequate incentive for regional governments. As an illustration, the year 2000 budget for DKP is 498 billion rupiah. Of this, 70 billion funds the Direktorat Genderal Pesisir dan Pulau-Pulau Kecil, and 13 billion rupiah are used for grants to the provinces for coastal resource management and conservation. The funds are distributed based on proposals submitted to DKP from the provinces (Rudianto, 2001).

The most promising possibility is that the central government can use specific allocation funds under the APBN equilibrium fund to support an ICRM program. These monies, pursuant to Article 8 of Act No. 25/1999, are not required to be distributed to regional governments, but are available for specific needs. According to Article 8(2)(b), this includes national priorities, which certainly can be enunciated to include ICRM. The central government would make distributions from this fund to regional governments that have ICRM plans approved by the central government, or that are initiating plans to submit for approval. It does not appear that the central government has any discretion to change the regional allocation, or to attach any conditions to the distribution under Article 7 of Act No. 25/2000.

A third, more visionary possibility would require a new act and amendments to Law No. 25/1999. It would also cure the most profound shortcoming in the new financial decentralization scheme. This shortcoming concerns the freedom of the regional governments to use natural resource revenues for any purpose whatsoever. These revenues can be used for administration, development, physical infrastructure, social infrastructure, etc. The freedom, of course, is desirable, but what is missing is a requirement that some of those revenues be reinvested in the management and conservation of natural resources - the very resources responsible for generating those revenues in the first place. A shortsighted regional government will extract natural resources to the point that they are depleted or overexploited, thus destroying its future revenue stream and depriving future generations of meeting basic needs through these same resources.

Consequently, the central government should amend the fiscal decentralization regime to impose a requirement that regional governments use some specific percentage of their revenues generated from natural resources for natural resource conservation and management. The concept of establishing a reserve derived from revenues is similar to the Reforestration Fund, used for replanting areas harvested for timber resources. Under Act No. 25, regional governments have several sources of new funding: original revenue receipts, equilibrium funds, and loans. It is only a portion of the equilibirum fund - that portion which, according to Article 6(1)(a), is derived from natural resources - that would be subject to this new requirement. Consequently, the restrictions would not be too onerous, with complete regional automony still available for other revenue sources.

Under this hypoethetical scenario, an ICRM program could be funded through the revenues derived from natural resource use, specifically revenues derived from fisheries. As discussed above, these revenues are treated as a common resource and are to be divided equally across all regional governments. However, under a new law, the central government could hold some portion of these revenues in escrow for individual regional governments until these governments engaged in developing and implementing an approved ICRM program. This may be politically infeasible at this point, but given the constant shifts taking place in implementation of decentralization, it should be entertained considering the tremendous potential for resource damage and loss that Indonesia faces without immediate action.

CONCLUSION

In terms of the four overarching questions regarding the feasibility of an integrated coastal management program in Indonesia, this paper attempts to provide concrete answers.

(1) What should be the role of the central government in such a program? Given the legal and political climate in Indonesia, the central government should remain faithful to the principles of decentralization and regional autonomy. Consequently, it should not take a heavy-handed approach to coastal management, but rather create a voluntary program based on incentives. To be sure, there may need to be mandatory requirements for specific pollution controls, and controls over other types of impacts, but an overall coastal management program should be voluntary. Minimal standards and criteria would need to be ensured through a certification process if benefits are to accrue to the regional governments. While the Ministry of Marine Affairs and Fisheries should have the lead in managing the program, if the program is to rise above sectoral politics and policies, there should be an inter-agency body that has respect and coordinating authority above all ministries, with disputes to be resolved by the President.

(2) Who in the regional government should be responsible? All levels of regional government - kecematan, regency and province - need to be involved with coastal management if it is to be a successfully vertically and horizontally integrated program The bulk of management responsibility must lie with the regency. However, coordination among regencies, and between regencies and the central government, should be accomplished by the provinces. Furthermore, the regencies will need to involve desas and communities in planning and management, and rely on their input for developing programs.

(3) What incentives exist to implement the program? The incentives should come in the form of financial and technical assistance. In addition, the central government should comply any regency ICRM approved program as additional incentive for regencies to seek approval for a voluntary program.

(4) How will the program be funded? Of course, under Act No. 25, the majority of funds to implement regency programs will come directly from original revenues or revenues from taxes and natural resource consumption. However, the central government can fund an integrated coastal management program through discretionary funding using its own share of general allocation fund under the equilibrium fund, or using specific allocation funds under the equilibrium fund.

Assuming that an ICRM program would be a voluntary, incentive-based program, regency, provincial and central governments could enter into special arrangements as they saw fit. The transfer of authority from regencies to the provinces for certain issues, and the agreement of regencies to have their activities reviewed by the central government, would be conditions for their receipt of incentives and other benefits. This is not required under Act No. 22/1999, but certainly allowed under Act No. 22/1999, and would lend the program greater ease in execution and coordination. The flexibility allowed under that law is powerful, and can be used to create innovative, collaborative programs for natural resource management. Indeed, an integrated, decentralized coastal resources management program is only one such example of the ways in which decentralization can further natural resource conservation in Indonesia.

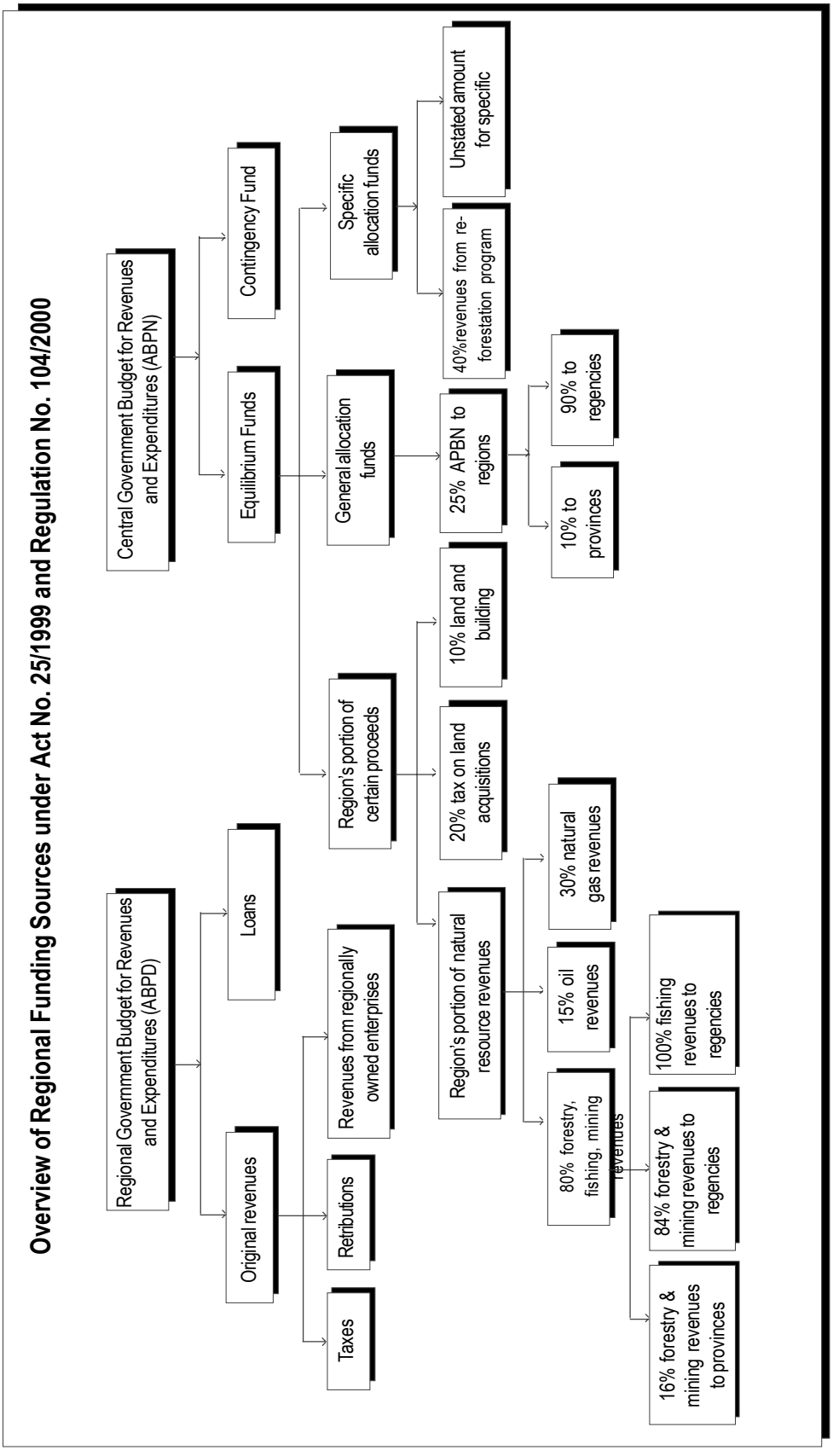

Figure 1. Funding for regencies and provinces is comprised of a multitude of sources, a combination of original revenues from their own ABPD, and funding from the central government's ABPN. This diagram depicts the breakdown of various accounts and revenue streams that make up regional funding sources. © Jason Patlis Fulbright Senior Scholar, 2000.

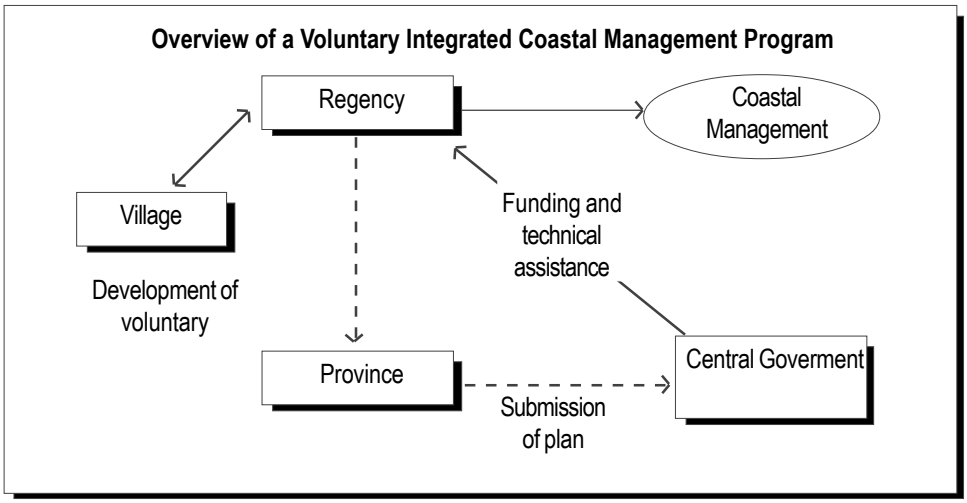

Figure 2. The kabupaten has authority to manage coastal resources directly, or it will have the option to work with desas and the province to develop a plan for submission to the central government. If approved, the central government will provide funding and technical assistance for coastal management. © Jason Patlis, Fulbright Senior Scholar, 2000

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1 A note on terminology: this paper uses the terms 'regency' and 'district' interchangeably, translating into 'kabupaten' in Bahasa Indonesia. Other terms used include 'city' ('kota'), which, under Indonesian law, has the same jurisdictional authority as kabupaten. 'Regional government'refers to both the regency and provincial levels. This paper also uses the term 'act' (undang-undang) to describe a law that is enacted by the national parliament (DPR) and signed by the President of the Republic of Indonesia. 'Undang-undang' is often translated as 'law,' but as noted by Mr. Koesnadi Hardjasoemantri, the term 'law' is a general reference to governing rules and regulations, rather than the particular type of rule constituting an 'undang-undang.'

2 There is some debate as to the meaning of the clause "pursuant to law" in that paragraph, and whether this clause gives the regions authority only insofar as existing national laws allow, which effectively would undermine much of the authority that Act No. 22/1999 purports to give to the regions. The authors believe that the language is sufficiently clear that regional governments still must comply with obligatory national laws.

3 Specifically, protected areas are established under Act No. 9/1985 relating to Fisheries, under Act No. 5/1990 relating to Conservation, under Act No. 41/1999 relating to Forestry, and under Act No. 24/1992, regarding spatial planning.

REGIONAL DISTRIBUTION PATTERNS OF *ACROPORA* AND THEIR USE IN THE CONSERVATION OF CORAL REEFS IN INDONESIA

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ABSTRACT

Distribution patterns of corals of the genus *Acropora* in Indonesia are examined for the contribution they can make to the management and conservation of Indonesia's coral reefs. The Indonesian Archipelago contains the greatest recorded diversity for the genus worldwide (91 species). Distribution patterns indicate that regional differences occur within the archipelago and that these are influenced by an overlap of Indian Ocean species distributions diminishing eastwards and a stronger pattern of Pacific Ocean species distributions diminishing westwards under the influence of the Pacific through-flow current. Eighteen percent of *Acropora* species within the archipelago are restricted to designated regions. This strong biogeographical demarcation is complemented by a diversity of *Acropora* within the archipelago due to the occurrence of a broad range of reef types and contrasting environmental conditions. Results of this research suggest some *Acropora* fauna is restricted to particular reef and habitat types in designated regions. This new information has important implications for the origins of coral distribution patterns, the interconnectedness of coral reef environments, and the importance of habitat diversity to conservation. Such information can be used to inform management, and when combined with data from other marine organisms, can provide strategic guidelines for the conservation of coral reefs in Indonesia.
Keywords : *Acropora*, coral reefs

ABSTRAK

Pola distribusi terumbu karang genus *Acropora* di Indonesia telah dikaji untuk mengetahui kontribusinya pada pengelolaan dan konservasi terumbu karang di Indonesia. Negara kepulauan Indonesia memiliki keanekaragaman yang tertinggi di dunia (tercatat 91 spesies). Pola distribusi menunjukkan bahwa perbedaan regional terjadi di dalam kepulauan Indonesia. Hal ini dipengaruhi oleh tumpang tindih antara distribusi spesies Lautan Hindia yang semakin melemah ke arah timur, dengan pola distribusi Lautan Pasifik yang lebih kuat dan melemah ke arah barat di bawah pengaruh arus lintas Pasifik. Delapan belas persen spesies *Acropora* di kepulauan Indonesia terbatas pada daerah tertentu. Batas biogeografi yang kuat ini ditunjang oleh keanekaragaman *Acropora* di dalam kepulauan karena adanya kisaran yang lebar dari *Acropora* per karang dan kondisi lingkungan yang kontras. Hasil dari penelitian ini menunjukkan bahwa beberapa fauna *Acropora* dibatasi pada karang dan tipe habitat tertentu di daerah yang dimaksud.

Informasi baru ini membawa implikasi penting bagi asal-usul pola distribusi karang, keterkaitan antar lingkungan terumbu karang, dan pentingnya keanekaragaman habitat bagi konservasi. Selain itu, informasi tersebut dapat digunakan untuk pengelolaan, dan kalau dikombinasikan dengan data biota laut lainnya dapat memberikan panduan strategis bagi konservasi terumbu karang di Indonesia.
Kata kunci: Acropora, terumbu karang

INTRODUCTION

Management plans for the conservation of coral reefs can be greatly enhanced by accurate information regarding the species composition and distribution of taxa within and between different geographical regions. Detailed information on regional distribution patterns of the reef-building coral genus *Acropora* in Indonesia is now available and can provide guidelines for coral reef conservation in Indonesia.

Acropora is the most diverse hermatypic coral genus with 114 species recognised worldwide and 91 species being identified for the Indonesian archipelago overall (Wallace, 1999a). "Structural species" such as *Acropora* are a vital ecosystem component, and variations in their abundance are critical to the dynamics of entire reef communities (Connell et al., 1997). *Acropora* plays a dominant role in the species composition and abundance of many modern day Indonesian reefs (Suharsono et al., 1985; Boekschoten, et al., 1989; Suharsono, 1992).

The taxonomy and distribution of *Acropora* have recently been revised for Indonesia (Wallace and Wolstenholme, 1998). As part of this revision, nine species (*A. batunai*, *A. suharsonoi, A. sukarnoi, A. awi, A. indonesia, A. derawanensis, A. desalwii, A. togianensis* and *A. halmaherae*) were newly described (Wallace, 1994, 1997; Wallace and Wolstenholme, 1998). Some of these species have since been recorded outside Indonesia (Wallace, 1999a; Veron, 2000; D. Fenner, pers comm).

In this paper we examine the distribution of *Acropora* within Indonesia to assess regional patterns and their potential to provide strategic information for the management and conservation of Indonesia's coral reefs. In particular, we look for:

1. Regional species composition
2. Regionally restricted species
3. Habitat specific assemblages
4. Biogeographic affinities within and external to Indonesia
5. Unique or rare faunal assemblages

Coral Reef Conservation in Indonesia

A long history of research (Rumphius, 1750, Umbgrove, 1940, 1946; Wijsman-Best, 1977, Suharsono *et al.,* 1985; Moll and Suharsono, 1986; Sukarno *et al.,* 1986; Best and Boekschoten, 1988; Hoeksema, 1989; van Duyl, 1991; Suharsono, 1992, 1993, 1994a,b; Erdmann, *et al.,* 2000), has indicated that Indonesian coral reefs are high in marine diversity and of high conservation value. The complexity of habitats and contrasting environmental conditions (Wallace and Wolstenholme, 1998), has resulted in coral assemblages in different parts of the Indonesian archipelago differing greatly from one another (Randall and Eldredge, 1983; Best *et al.,* 1989; Hoeksema and Putra, 2000). Given this variety of habitat types, an inventory of coral species assemblages is incomplete (Sukarno *et al.*, 1986; Wallace, 1997; Hopley and Suharsono, 2000). It has been suggested that up to 40% of coral species within the archipelago are restricted to special habitats or classified as rare to very rare (Best and Boekschoten, 1989). Similar patterns have been recorded for other reef organisms in the archipelago (Polunin, 1983; Allard *et al.,* 2000, Erdman *et al.,* 2000). However, data about coral distributions has not as yet been used to inform conservation practices in Indonesia.

At the national level, there are limited management provisions to protect coral reefs in Indonesia (Sloan and Sugandhy, 1994). Existing protected areas include: Tukang Besi, Bunaken, Taka Bonerate, Pulau Kasa, Kepulauan Wakatobi, Kepulauan Seribu, Ujung Kulon, Teluk Cenderawasih, and Komodo marine parks and a series of other smaller areas (Lawrence, 1998). Throughout the archipelago, overexploitation, destructive fishing practices (Tomascik *et al.*, 1993) and mass bleaching events (Westmacott *et al.*, 2000), have resulted in clear indications of rapidly declining reef health (Wilkinson, 2000). Hopley and Suharsono (2000) estimated that up to 50% of reefs have been degraded in the last 50 years. As a result, it is considered that protecting the diversity of remaining living corals is essential for maintaining sources of coral larvae, which are crucial to future reef recovery on a local and global scale (Pearson, 1981; Brown and Suharsono, 1990; Done, 1994, 1995; Tomascik *et al.*, 1996; Westmacott *et al.*, 2000; Babcock, *et al.*, 2000).

Monitoring of Indonesian reefs indicates that there is little difference in reef condition between reefs in protected and non-protected areas (Wilkinson, 2000). It has been suggested that existing marine conservation reserves in Indonesia are either too small to be fully effective, inappropri-

ately located, poorly demarcated or inadequately protected from illegal activities (Allard, *et al.*, 2000). Some diverse or unique regions of the archipelago are not managed within a protected area framework. Examples include the Halmahera region, adjacent waters linking New Guinea to a putative node of high diversity of the Banda Sea, and the islands off the east coast of Central Sulawesi, especially the Togian Islands (UNDP/FAO, 1982; Hopley and Suharsono, 2000). Such deficiencies in Indonesian marine resource conservation strategies have been recognised over some time (Knox and Miyabara, 1984; Burbidge *et al.*, 1988; Alder *et al.,* 1994a,b; Ongkosongo and Natsir, 1994). We propose that information derived from *Acropora* distribution patterns will facilitate biogeographic analysis regarding the origins of coral distribution patterns, the nature of habitat diversity, and the patterns and connections within and between marine environments in Indonesia. This will enable future management plans to accommodate the needs of successful biodiversity conservation.

METHODS

This study is based on surveys made between 1994 and 2000, preceded by preliminary collecting by Suharsono and LIPI staff from 1990 and with the addition of further specimens provided to the authors by a number of researchers during the study period.

Locations

The Indonesian archipelago was divided into six arbitrarily defined "regions": Sumatra, Indonesia Central, Indonesia South, Sulawesi Sea, Bay of Tomini and the Banda Sea (Figure 2). Between October 1993 and October 2000, 146 survey sites were sampled by the detailed protocol indicated below. Details of the sites are given in Appendix 1. A further 98 sites were sampled opportunistically either by the authors or by other researchers during other surveys or research programs (these are marked by an asterix in the appendix). Characteristics of the regions investigated in this study are summarised in Table 1.

Table 1. General Physical characteristics and the number of reefs sampled for each region

Region	Description	Reef Types	Max Depth	No. Sites
Sumatra	An area adjacent to the Indian Ocean and to the west of the Pacific Through-flow zones.	Fringing Submerged Coral Cay	200 m	11
Indonesia Central	Reefs located mostly on the Asian continental shelf and post-Pleistocene in origin. Therefore surrounded by shallow seas.	Fringing Patch Reef Coral/Sand Cay Shoal	300 m	21
Indonesia South	Reefs of the Nusa Tengara Island chain, between the Banda Sea and the Indian Ocean	Fringing Coral/Sand Cay Submerged/Patch	300 m	54
Sulawesi Sea	Reefs of north and western Indonesia, exposed to the Pacific Ocean and the Pacific Through-flow	Fringing/Rocky Submerged/Patch Coral/Sand Cay Volcanic slope	4 000 m	80
Bay of Tomini	Reefs of a deepwater bay, connected on its eastern side to the Banda Sea and including the reefs of the Togian Islands.	Barrier/ Fringing Submerged/Patch Atoll	2 000 m	26
Banda Sea	Isolated reef groups rising from depths of up to 2, 000 m, in a sea with some exposure to the Pacific Ocean in the north and Indian Ocean in the south.	Fringing/Rocky Submerged Patch Reef Atoll	2 500 m	52

Table 2. Distribution of Acropora species within Indonesia. x = species present; blank = species absent; I-P = Indo-Pacific Indonesian; IND = Indian Ocean Shared; PAC = Pacific Ocean Shared and ARC = Indonesia. Highlighted boxes are species occurring in one region only. Groups and species are defined in Wallace (1999a).

			Area					
Group	**Species**	**Category**	**Sumatra**	**Indonesia Central**	**Indonesia South**	**Sulawesi Sea**	**Bay of Tomini**	**Banda Sea**
rudis	*A. rudis*	IND	x					
	A. austera	I-P	x	x	x	x	x	x
humilis	*A. humilis*	I-P	x	x	x	x	x	x
	A. gemmifera	I-P	x	x	x	x	x	x
	A. monticulosa	I-P				x		
	A. samoensis	I-P	x	x	x	x	x	x
	A. digitifera	I-P	x	x	x	x	x	x
	A. multiacuta	I-P			x		x	
nasuta	*A. nasuta*	I-P	x	x	x	x	x	x
	A. cerealis	I-P	x	x	x	x	x	x
	A. valida	I-P	x	x	x	x	x	x
	A. secale	I-P	x	x	x	x	x	x
	A. lutkeni	I-P	x	x	x	x		x
	A. kimbeensis	PAC					x	
divaricata	*A. divaricata*	I-P	x	x	x	x	x	x
	A. solitaryensis	I-P	x	x	x	x	x	x
	A. kosurini	IND	x					
	A. hoeksemai	I-P		x	x	x	x	x
	A. clathrata	I-P	x	x	x	x	x	x
lovelli	*A. glauca*	I-P	x		x			
muricata	*A. muricata*	I-P	x	x	x	x	x	x
	A. grandis	I-P		x	x	x	x	x
	A. acuminata	I-P		x	x	x	x	x
	A. valenciennesi	I-P	x	x	x	x	x	x
robusta	*A. robusta*	I-P	x	x	x	x	x	x
	A. abrotanoides	I-P	x		x	x	x	x
	A. palmerae	I-P			x			
	A. intermedia	I-P	x	x	x	x	x	x
	A. polystoma	I-P		x	x	x	x	x
	A. listeri	I-P			x	x	x	x
	A. sukarnoi	IND	x		x			
togianensis	*A. togianensis*	ARC					x	
selago	*A. selago*	I-P	x	x	x	x	x	x
	A. tenuis	I-P	x	x	x	x	x	x
	A. striata	I-P		x	x	x	x	x
	A. donei	I-P	x	x	x	x	x	x
	A. yongei	I-P		x	x	x	x	x
	A. loisetteae	IND				x	x	
aspera	*A. aspera*	I-P		x	x	x	x	x
	A. pulchra	I-P		x	x	x	x	x
	A. millepora	I-P		x	x	x	x	x
	A. spicifera	I-P	x	x	x	x	x	x
	A. papillare	I-P			x	x		x
florida	*A. florida*	I-P	x	x	x	x	x	x
	A. sarmentosa	I-P		x		x	x	
hyacinthus	*A. hyacinthus*	I-P	x	x	x	x	x	x
	A. anthocercis	I-P	x				x	x
	A. cytherea	I-P	x	x	x	x	x	x
	A. microclados	I-P		x	x	x	x	x
	A. paniculata	I-P		x	x	x	x	x
	A. indonesia	ARC	x	x	x	x	x	x
latistella	*A. latistella*	I-P	x	x	x	x	x	x
	A. subulata	I-P	x	x	x	x	x	x
	A. nana	I-P		x	x	x	x	x
	A. aculeus	I-P	x	x	x	x	x	x
horrida	*A. horrida*	I-P		x	x	x	x	x
	A. vaughani	I-P		x	x	x	x	x
	A. abrolhosensis	I-P		x	x	x	x	x
	A. microphthalma	I-P	x	x	x	x	x	x
	A. kirstyae	PAC				x	x	
	A. tortuosa	I-P					x	
	A. derawanensis	PAC				x	x	
	A. halmaherae	PAC				x		
pulmosa	*A. plumosa*	PAC		x		x	x	x
elegans	*A. elegans*	PAC		x			x	
	A. pichoni	PAC					x	
	A. tenella	PAC					x	
	A. russelli	IND				x		x
loripes	*A. loripes*	I-P	x	x	x	x	x	x
	A. lokani	PAC			x	x	x	
	A. granulosa	I-P	x	x	x	x	x	x
	A. speciosa	PAC		x		x	x	x
	A. suharsonoi	ARC			x			
	A. caroliniana	I-P			x	x	x	x
	A. desalwii	ARC				x		x
	A. jacquelineae	PAC		x	x	x	x	x
	A. simplex	ARC					x	
echinata	*A. echinata*	I-P		x	x	x	x	x
	A. batunai	PAC					x	
	A. subglabra	I-P		x	x	x	x	x
	A. carduus	I-P		x	x	x	x	x
	A. awi	PAC		x	x	x	x	
	A. elseyi	I-P	x		x	x	x	x
	A. longicyathus	I-P		x		x	x	x
	A. turaki	I-P		x	x	x	x	x
Isopora	*A. palifera*	I-P	x	x	x	x	x	x
	A. cuneata	PAC				x	x	x
	A. crateriformis	PAC				x		
	A. brueggemanni	I-P	x	x	x	x	x	x
Unidentified	Unid. spp. 1	Unknown					x	
	Unid. spp. 2	Unknown					x	
Total Number of Species			**40**	**59**	**65**	**73**	**78**	**65**

Sampling and database protocol

At the 146 survey sites, sampling followed a standard protocol, using SCUBA, or occasionally snorkelling or reef-walking on shallow sites. The presence of Acropora species was recorded, beginning from the greatest depth at which they could be located (usually 25-28 m) and continuing upwards to shallow water, over a horizontal distance of 100-400 m. Sites were assigned to the following overall reef types: fringing, coral cay, sand cay, submerged reef, shoal, patch reef, rocky reef, volcanic ash slope, deep reef flat, barrier reef, and pinnacles (Tomascik, 1997). Within each reef type, the particular habitat sampled was categorised according to the following categories: (1) recent volcanic surface, (2) reef slope and associated flat, (3) reef wall and associated flat, (4) lagoons, sheltered inlets or submerged reefs (Wallace and Wolstenholme, 1998). Habitat features and dominant benthic groups were noted for each site. Small samples of each species encountered were taken for verification and more colonies were sampled (for taxonomic description) when unusual forms were encountered. Most specimens were photographed in situ before collection. An initial identification, including colour of the colony, unusual size or colony shape, and depth were recorded. A numbered plastic label was attached to each specimen as it was collected. After sampling, specimens were bleached in 3% NaOCl, rinsed in fresh water, and dried. Specimen identifications were later verified by microscopic examination in the laboratory. A complete set of voucher specimens for the sites is stored at the Museum of Tropical Queensland in Townsville, Australia, and registered on a database that includes coordinate data for GIS mapping.

Additional sets of specimens were deposited with the Indonesian Institute of Science (LIPI), LIPI Research and Development Centre for Oceanology (PPPO) at Ancol, Java (Sulawesi Sea and Bay of Tomini collection); LIPI PPPO at Ambon, Moluku Province (Banda Sea collection); and Department of Marine Science, Bung Hatta University Padang, Sumatra (Sumatra collection).

Mapping of species distributions

The specimen-based database was used to prepare a distribution list for each species in ASCII format, including site coordinates for each specimen record. These lists were used to plot the distribution records for each species in Indonesia, using a MAPINFO Geographic Information System package for WINDOWS.

Similarity between regions

Comparisons between regions were based on Jaccard's similarity coefficient. (Similarity = a/a+b+c, using the number of species in common, where a = number of species shared by two regions being compared, b = number of species in sample 1 and not in sample 2, and c = number of species in sample 2 not in sample 1). Note that (a+b+c) = the total number of species in the two areas. This measure was chosen for simplicity and because it is not sensitive to the presence of species in a wider region that are not present in the two areas being compared, that is joint absences (Batagelj and Bren, 1995).

Table 3. Number of *Acropora* species in each distribution category for each region within Indonesia.
* Two new species included in this distribution category.

Distribution Category	Sumatra	Indonesia Central	Indonesia South	Sulawesi Sea	Bay of Tomini	Banda Sea
Indian Ocean Shared (IND)	2	0	1	2	1	1
Indo-Pacific Indonesian (I-P)	36	53	59	59	58	58
Pacific Ocean Shared (PAC)	1	6	4	10	13	4
Indonesia Only (ARC)	1	0	1	2	6*	2
Total number of species	**40**	**59**	**65**	**73**	**78**	**65**

Types of distribution exhibited by species

In order to examine the similarities between areas, we examined the distribution ranges exhibited by the species themselves. To do this, species were allocated to worldwide distribution categories on the basis of the number and positioning of the locations throughout the world they occupy (Table 2). Distribution categories to which species were allocated are: Indian Ocean shared (IND), Indo-Pacific Indonesian (I-P), Pacific Ocean shared (PAC), and the Indonesian archipelago only (ARC).

RESULTS

Species Composition

Ninety-one species of *Acropora* were recorded within the Indonesian archipelago. The greatest number of species recorded in any one region was 78, recorded for the Bay of Tomini in central Sulawesi (Table 3). The next highest result was for the Sulawesi Sea with 73 species being recorded. Indonesia South and Banda Sea, each recorded 65 species. The regions with the lowest number of species recorded were Indonesia Central (59) and Sumatra (40).

The majority of species (63 out of a possible 91) are broadly distributed throughout the Indian and Pacific Oceans as well as the Indonesian archipelago (Table 3, Figure 3). Of these, 32 species occur in all regions within the archipelago. There are three other significant distribution patterns: Five species are endemic to the archipelago (*A. suharsonoi* (Figure 1a), *A. indonesia* (Figure 1b), *A. desalwii* (Figure 1c), *A. togianensis* (Figure 1f), and *A. simplex*. Five species are shared between the Indian Ocean and Indonesia (*A. rudis, A. kosurini, A. sukarnoi, A. loisetteae, A. russelli*); and fifteen species are shared between the Pacific Ocean and Indonesia (*A. kimbeensis, A. kirstyae, A. derawanensis, A. halmaherae, A. plumosa, A. elegans, A pichoni, A. tenella, A. lokani*, *A. speciosa, A. jacquelineae, A. batunai, A. awi, A. cuneata, A. crateriformis*). *pichoni, A. tenella, A. halmaherae, A. batunai, A. craterformis*). Other internal affinities include five species that are restricted to one region in the archipelago and share their distribution pattern with the Western Pacific Ocean (*A. pichoni, A. tenella, A. halmaherae, A. batunai, A. craterformis*). Two species are restricted to one region in the archipelago and share their distribution broadly with the Indo-Pacific (*A. monticulosa, A. palmerae*). *Acropora rudis* and *A. kosurini* are restricted to the Sumatra region, and share their distribution with the Indian Ocean. One species (*A. indonesia*) occurred in all six regions within Indonesia, but has rarely been recorded in the Indian or Pacific Ocean assemblages, (Wallace, 1999a), with the exception of one record from Southern Philippines (D. Fenner, pers. Comm.). Two further species were recorded within the Bay of Tomini, however, these species have not yet been identified and their distribution pattern is not verified. One Pacific species, *A. tortuosa* that was recorded once within the Bay of Tomini has not been recorded elsewhere within the Indonesian archipelago.

Regionally Restricted Species

Eighteen percent of species within the Indonesian archipelago are restricted to one region. These restricted species occur in four regions: Sumatra, Indonesia South, Sulawesi Sea and the Bay of Tomini (Table 3, Figure 3). No restricted species were recorded within Central Indonesia or the Banda Sea. Sixteen species are, on present records, restricted to narrowly defined areas: The Bay of Tomini had nine restricted species (*A. kimbeensis, A. togianensis, A. tortuosa, A. pichoni, A. tenella, A. simplex, A. batunai*, and two new unidentified species). The Sulawesi Sea region has three restricted species (*A. monticulosa, A. halmaherae, Isopora Crateriformis*). *Acropora suharsonoi* and *A. palmerae* were only found within the South Indonesia region. Two species, *A. rudis* and *A. kosurini*, were found in the Sumatra region only.

Habitat Specific Assemblages

Reef type and habitat characteristics for the 146 survey sites are indicated in Appendix 1. Of these, 70 sites (48%) were dominated by *Acropora* (Appendix 1). The most common reef and habitat type sampled was the slope and associated reef flat on fringing reefs. The Sulawesi Sea has the most diverse variety of reef and habitat types (Table 1). Reef types were also diverse within the Bay of Tomini and this was the only region in which a well-developed barrier reef was sampled. Coral cays were absent from Indonesia South and the Banda Sea. Recent volcanic surfaces were sampled in Indonesia South, Sulawesi Sea and the Banda Sea, but not from the Bay of Tomini, although such surfaces

Table 4. Indonesian *Acropora* species occurring specific to habitat, reef type and region

Species	Habitat	Reef Type	Region
A. halmaherae	wall	fringing	Sulawesi Sea
A. palmerae	lagoon	fringing	Indonesia South
A. pichoni	wall	patch	Bay of Tomini
A. simplex	slope	submerged	Bay of Tomini
A. tortuosa	slope	fringing	Bay of Tomini
New sp. #2	wall	barrier, submerged	Bay of Tomini
A. kosurini	slope	coral cay, fringing	Sumatra
A. anthocercis	slope	fringing	Sumatra, Bay of Tomini, Banda Sea
A. loisetteae	wall	barrier	Sulawesi Sea, Bay of Tomini
A. russelli	slope	fringing	Sulawesi Sea, Banda Sea
A. sukarnoi	slope/lagoon	fringing	Sumatra, Indonesia South
A. elegans	slope/wall	patch	Indonesia Central, Bay of Tomini
A. crateriformis	slope/wall	fringing, rocky	Sulawesi Sea
New sp. # 1	slope/wall	barrier, fringing, patch	Bay of Tomini
A. togianensis	slope/lagoon	fringing, patch, submerged	Bay of Tomini
A. batunai	slope/wall	barrier, fringing, patch, submerged	Bay of Tomini
A. suharsonoi	slope/wall	fringing, shipwreck	Indonesia South
A. glauca	slope/lagoon	fringing, coral cay	Sumatra, Indonesia South
A. kirstyae	slope/lagoon	fringing, patch, submerged	Sulawesi Sea, Bay of Tomini
A. turaki	slope/lagoon	fringing, patch, submerged	All regions except Sumatra
A. cuneata	slope/lagoon	fringing, recent volcanic surface	Sulawesi S. Bay of Tomini, Banda Sea
A. desalwii	slope/wall	atoll, fringing, recent volcanic surface	Sulawesi Sea, Banda Sea

would be available on the volcano of Una Una. Steep walls and associated flats were common in the Sulawesi and Banda Seas and the Bay of Tomini (Table 1, Appendix 1). Results indicate five species are restricted to a single habitat type within a particular reef type in one region only (Table 4). *Acropora halmaherae* is restricted to steep walls on fringing reefs within the Sulawesi Sea, *A. palmerae* is restricted to lagoonal habitats on fringing reefs of Indonesia South, *A. pichoni* is restricted to steep walls on patch reefs of the Togian Islands, *A. simplex* is restricted to gentle slopes on submerged reefs within the Bay of Tomini and *A. tortuosa* was recorded only once from a slope habitat on a fringing reef within the Bay of Tomini. A further 17 species display distribution patterns specific to particular habitat and/or reef types in designated regions (Table 4). Of these, six species are restricted to slope and lagoonal habitats and three species are restricted to slopes alone. A further six species are restricted to slope and wall habitats with two species occurring only on steep walls.

Biogeographic Affinities Within Indonesia

Similarities between the designated regions within Indonesia are shown in Table 4. The greatest similarity of 86% is shown between the adjacent areas of Banda Sea and Sulawesi Sea. Other strong affinities occur between adjacent regions: Banda Sea and Indonesia Central (82%), Banda Sea and Indonesia South (81%); Bay of Tomini and Sulawesi Sea (78%); Sulawesi Sea and Indonesia Central (78%). Sumatra shows low similarity with all locations within the archipelago.

External to Indonesia

When the similarity of regions is examined in relation to a worldwide survey of *Acropora* distributions (Wallace, 1999a), two regions are shown to be more similar to regions outside Indonesia than to any of the internal regions. These are Sumatra (most similar to the Andaman Sea) and the Bay of Tomini which shows greater similarity to the non-contiguous area of Papua New Guinea (Figure 2).

Unusual Faunas

The Bay of Tomini has a unique faunal assemblage for Indonesia. Regionally restricted species (*A. togianensis*, Wallace, 1997 and *A. batunai*, Wallace, 1997) were recorded in abundance. Other species which are usually rare (eg. *A. multiacuta* Nemenzo, 1967 and *A. caroliniana* Nemenzo, 1967) were common within the Bay of Tomini. Two species new to science were found within the Bay, and not recorded from any other regions within the archipelago. One species, *A. tortuosa*, which occurred in

the Bay of Tomini has not been recorded before in Indonesia, but is common in some reefs of the western south Pacific. Other species in the bay are shared with northern Papua New Guinea only, making this fauna of great interest to biogeography.

DISCUSSION

This study shows that Indonesia can justly claim to be the location of the world's greatest diversity of staghorn corals. This diversity represents the geographic and paleo-historic range of the archipelago, which extends from the eastern edge of the Indian Ocean to the western edge of the Pacific Ocean and includes some of the world's most tectonically complex land and seascapes (Hall, 2000). From a breakdown of distribution types, it is clear that the assemblage of *Acropora* in Indonesia includes representative species from the Indian and the Pacific Oceans in addition to the major component of broadly Indo-Pacific species. Eighteen percent of *Acropora* species are regionally restricted within the archipelago. These patterns appear to be influenced by geographic position, water movement and the complexity of habitat types and environmental conditions occurring within the archipelago. The characteristics of each region relevant to conservation status and potential are discussed below.

Sumatra

The fauna of this region showed some unique characteristics that align it strongly with the Indian Ocean fauna. The presence of two regionally restricted species (*A. rudis* and *A. kosurini*), which have biogeographic affinities with the north east Indian Ocean, and do not occur further east in the archipelago is of great interest. *Acropora rudis* has only been found on fringing reefs and seems to be most common around Sri Lanka (Rajasurian, pers. comm.). *Acropora kosurini* is restricted to reef slope habitats on coral cays and fringing reefs, and is a common species in the Andaman Sea (Wallace, 1999a). It is interesting that out of all regions examined in this study, Sumatra and the Bay of Tomini are the most dissimilar. The very small number of species overall found in Sumatra is undoubtedly an underestimate. This region was the least investigated due to access difficulties during the time of the project. Additionally, the sites visited for "detailed protocol" surveys, particularly those on submerged reefs or coral cays had been heavily impacted by dynamiting and *Acanthaster planci.* A collection from Nias (made by M. Christensen in 1993) contributed substantially to the species listing.

Indonesia Central

The species composition of Indonesia Central is interesting as the region has a relatively low species count and no endemic species. Indonesia Central has been well studied and shown to be dominated by broad ranging Indo-Pacific species. This is considered to be a true record reflecting the lack of diversity in habitat types in the region (Hoeksema and Putra, 2000). One species, *Acropora elegans*, occurs only in Indonesia Central and the Bay of Tomini and is restricted to slope and wall habitats on patch reefs. Indications from this study suggest patch reefs of Indonesia Central are under pressure from dynamite fishing, *Acanthanster planci* out-

Table 5. Similarity matrix based upon an analysis of *Acropora* species diversity (Jaccard's Index) for the six geographic regions of Indonesia.

Region	Sumatra	Indonesia Central	Indonesia South	Sulawesi Sea	Bay of Tomini	Banda Sea
	Similarity between areas					
Sumatra	1	0.5	0.54	0.45	0.42	0.52
Indonesia C	33	1	0.77	0.78	0.73	0.82
Indonesia S	37	54	1	0.77	0.7	0.81
Sulawesi Sea	35	58	60	1	0.78	0.86
Bay of Tomini	35	58	59	66	1	0.74
Banda Sea	36	56	58	64	61	1
Number of species shared between areas						

breaks and heavy silt loads. It may be surmised that the species assemblage of Indonesia Central is a reflection of the region's position on the continental shelf and the relatively young age of coral reef communities having established in shallow water after the last ice age. This suggestion of a depauperate species composition on continental shelves contradicts with the species richness of other continental shelf reef communities such as the Great Barrier Reef. Recent estimates suggest the Great Barrier Reef comprises 73 species (Wallace, 1999a) which makes it the second most diverse assemblage of *Acropora* in the world. Despite the complexity of habitat types, reefs of the Indonesian archipelago are mostly characterised by the absence of extensive reef flats. This basic difference in reef structure means that the composition of Pacific and Indonesian reefs differ in that, reef flat species, although present in Indonesia, do not occur in the abundance that they exhibit on Pacific reefs (Wallace and Wolstenholme, 1998). Furthermore, some usually common reef flat species (such as *A. papillare, A. anthocercis, A. cuneata*) are absent from Indonesia Central.

Indonesia South

The topography of Indonesia South comprises many islands with strong currents and upwellings of cold water and nutrients from the edge of the Timor Shelf. As a result, the region has a moderately diverse species composition. It is dominated by species shared with the Pacific Ocean and broad Indo-Pacific species. Two species are restricted to Indonesia South (*A. suharsonoi* and *A. palmerae*). *A. suharsonoi* is a rare and distinctive species restricted to slopes and walls of fringing reefs or recent volcanic surfaces in Bali and Lombok. *A. palmerae* occurs in lagoonal habitats on fringing reefs. Another species, *A. sukarnoi* occurs only on slopes and in lagoons of fringing reefs in Indonesia South and Sumatra. Reefs of this region show signs of degradation from dynamite fishing and mass bleaching events along with natural disturbances such as earthquakes and tidal-waves. Previous research has shown the species composition of Southern Indonesia to be strongly aligned with the north west shelf of Western Australia (Wallace, 1999a). This biogeographical affinity suggests that a variety of Indian Ocean faunas would be present within Southern Indonesia however, apart from *A. sukarnoi*, this is not the case.

Sulawesi Sea

The Sulawesi Sea region has the second highest *Acropora* species count for the Indonesian archipelago. Three species (*A. monticulosa, A. halmaherae* and *A. craterformis*) are restricted to within the Sulawesi Sea region. *Acropora monticulosa* is most common in habitats with strong currents or wave movement (Wallace, 1999a). *Acropora halmaherae* was found only on protected walls of fringing reefs, *A. craterformis* recorded only from slopes and walls of fringing and rocky reefs. The species composition of Sulawesi Sea is strongly aligned to the Banda Sea, but also similar to the Bay of Tomini and Indonesia Central. This similarity is most likely a result of the exchange of propagules between regions due to the Pacific through-flow current. Previous research has shown that external to Indonesia, the Sulawesi Sea is most similar in *Acropora* species composition to China, the South China Sea and the Philippines (Wallace, 1999a).

Bay of Tomini

Much of the sampling within the Bay of Tomini was undertaken in the vicinity of the Togian Islands due to the particularly unusual *Acropora* fauna present (Wallace, 1997). The Togian Islands is not only one of the most diverse regions known for the genus *Acropora* (Wallace and Wolstenholme, 1998), but one of the most unique.

The assemblages of *Acropora* for the Bay of Tomini are different in species composition and relative abundance from any previously recorded. The species numbers exceed that of any other locality. Twelve percent of species within the Bay are regionally restricted. One of these regionally restricted species, *A. pichoni* occurs only on walls of patch reefs and another, *A. simplex* is restricted to slope habitats on submerged reefs. The presence of one colony of *A. tortuosa* on the slope of a fringing reef in the Bay of Tomini is unusual in that the distribution of this species is concentrated in the central Pacific Ocean, and it has never before been recorded within the Indonesian archipelago. *Acropora togianensis* was newly described by Wallace and Wolstenholme in 1998. Research indicates this species only occurs in slope and lagoonal habitats on fringing, patch and submerged reefs of the Togian Islands. Two species, new to science which were recorded from barrier reef locations in the Togian Islands are not fully documented and further sam-

pling will reveal information about their character and distribution. The diversity and unique assemblage of the region may be due to the unusual combination of habitat types, which are sheltered from the two opposing monsoonal systems that influence north and south Sulawesi Sea. Furthermore, the Pacific through-flow system bypasses the Bay of Tomini and it enclosed waters, hence the exchange of water with areas outside the Bay is restricted.

One species, *Acropora batunai* occurs in the Bay of Tomini and no other region in the Indonesian archipelago, however it has a shared distribution with northern Papua New Guinea. Interesting questions in historical biogeography arise when you consider that the *Acropora* fauna within the Bay of Tomini is unlike the neighbouring regions and most similar to northern Papua New Guinea. It is likely habitats suitable for the survival of some *Acropora* species have persisted through time (Wallace, 1999b) and acted as a refuge during the during the late Cenozoic sea level fluctuations (Rosen, 1984). The regionally restricted species of the Togian Islands are hypothesised to indicate the remnants of a fauna derived with the Pacific Ocean or Central Indo-Pacific (Wallace, 1999b).

Banda Sea

The Banda Sea has an unusual faunal composition comprising no regionally restricted species. The topography of the Banda Sea is of special interest, comprising very deep water with isolated reefs of varying types including seamounts and atoll-type formations. The lack of restricted species in this region may be a result of the open exchange of water from this to surrounding regions such as Sulawesi Sea. This is supported by the strong affinity shown between the Banda Sea and Sulawesi Sea. Further evidence of a connection between these regions is evident when you consider the distribution of *A. russelli.* This species occurs only on slopes of fringing reefs in the Sulawesi and Banda Seas. Indonesia Central and Indonesia South are also strongly aligned with the Banda Sea. One species, *A. desalwii*, which is endemic to the Indonesian archipelago overall is most abundant on slopes and walls of atolls and fringing reefs in the Banda Sea, its distribution is shared only with some adjacent reefs groups in Halmahera (Wallace, 1999a). Despite their isolation, reefs of the Banda Sea are under pressure from dynamite fishing, and volcanic activity has an enormous influence on the topography of the region. Some parts of the Banda Sea (in particular Irian Jaya and the Kai Islands) were not sampled extensively. A study of these areas could be expected to lead to greater species numbers for this region.

***Acropora* and Coral Reef Conservation**

Regional distribution patterns of *Acropora* within the Indonesian archipelago indicate that the composition and abundance of *Acropora* communities is related to geographic position, reef and habitat type and environmental conditions (Wallace, 1999a). This finding underscores the importance of conserving representatives of all reef and habitat types across the reef profile, and incorporating information about reef interconnectedness and patterns of larval recruitment into management practice.

As evidenced by geological history, reefs within the "Wallacea" area of the Indonesian archipelago are durable and have provided a refuge for *Acropora* corals during both geological and modern times (Wallace, 2001). The presence of very high *Acropora* biodiversity, a unique assemblage featuring endemic species, a high number of regionally restricted species and species restricted to particular reef and habitat types indicates that reefs of the Indonesian archipelago have a high conservation status. Some species such as *A. caroliniana* and *A. multiacuta* are rare or absent from most reefs in the world, but occur in abundance within some regions of the archipelago.

Undoubtedly, the best examples of thriving coral reefs exist at some distance from major cities. However, many diverse and unique reefs are under pressure from blast and cyanide fishing, along with climate change. Rare species with a restricted habitat such as *A. halmaherae, A. pichoni, A. tortuosa* and *A. simplex* are under particular threat by the pressures associated with over-use.

Of particular concern is the Togian Islands in the Bay of Tomini. This mini archipelago is considered to be the best representative of a coral reef environment in a sheltered location. Apart from featuring the most diverse assemblage of *Acropora* in the world, this region contains a flourishing community of endemic and restricted species such as *A. togianensis* and *A. batunai* respectively. The restricted habitat of these species and lack of protection for

the region as a whole makes the entire assemblage vulnerable to degradation. A study of this region along with its "sister region", New Britain in Papua New Guinea is leading to hypothesis about the existence of a possible pre-Pleistocene fauna that survived sea level changes because of the great depth of its surrounding waters.

The *Acropora* assemblage of Sumatra is unique in that it features two regionally restricted Indian Ocean species (*A. rudis* and *A. kosurini*), that are not represented elsewhere in the archipelago. These species belong to two of the oldest *Acropora* lineages (Wallace, 1999a). There is some concern for the future of this ancient fauna as evidence indicates that Indian Ocean coral fauna are particularly vulnerable to increased sea surface temperatures associated with global warming (Westmacott, et al., 2000). The limited distribution pattern of these species, which includes Sri Lanka, Thailand and the Andaman Sea (Wallace, 1999a), means that they are under increasing threat from the pressures associated with dynamite fishing and *Acanthaster planci* outbreaks. This finding highlights the need to provide protection for reefs of the western provinces in order to maximise the chance of coral assemblages recovering after bleaching events.

This study was carried out mostly before the coral bleaching events of 1998-9, and without reference to factors impacting on coral growth and health. However, it has been suggested that out of all regions in the Indonesian archipelago, reefs of central Indonesia had the highest rate of survival after the 1998 mass bleaching event due to the upwelling of cooler deep waters (Westmacott et al., 2000). The return of a coral reef ecosystem to a functional state after mass bleaching mortality will depend on successful reproduction and recolonisation by remaining corals and by corals from outside the ecosystem (Done, 1994; 1995). The strong similarity between adjacent regions demonstrates the presence of connections between regions and underscores the importance of source reefs. Hence, reefs of the eastern archipelago are an important source of progeny for seeding populations throughout the entire archipelago.

While the regions chosen for this study are arbitrarily defined, we believe that their varying composition and geographic boundaries provide guidelines that will prove useful for decision-making when combined with other data about the marine environments and organisms of Indonesia. As an example of this, the regions defined in this study could be seen in the following summary terms on the basis of their *Acropora* composition and resulting geographic and/or paleo-historic affinities:

"Indian Ocean Component" (Sumatra)
"Pre-Pleistocene Component" (Bay of Tomini)
"Pacific Access Component" (Sulawesi Sea)
"Banda Deepwater Component" (Banda Sea)
"Uniquely Nusa Tenggara Component" (Indonesia South)
"Post-Pleistocene Component" (Indonesia Central)

In the light of limited economic resources, the identification of regional components based on species composition and underlying geographic and/or paleo-historic causes is a basic managerial step. Such units, when combined with information about other marine organisms, could be seen as a basis for selecting subunits for protection. This research has used the significant coral genus *Acropora* to demonstrate the need to protect coral reefs of the Indonesian archipelago. It is anticipated that managers of this important region will use this new information to inform management practice, and work towards combining knowledge from the past with the present, to help conserve coral reefs of the Indonesian archipelago in the future.

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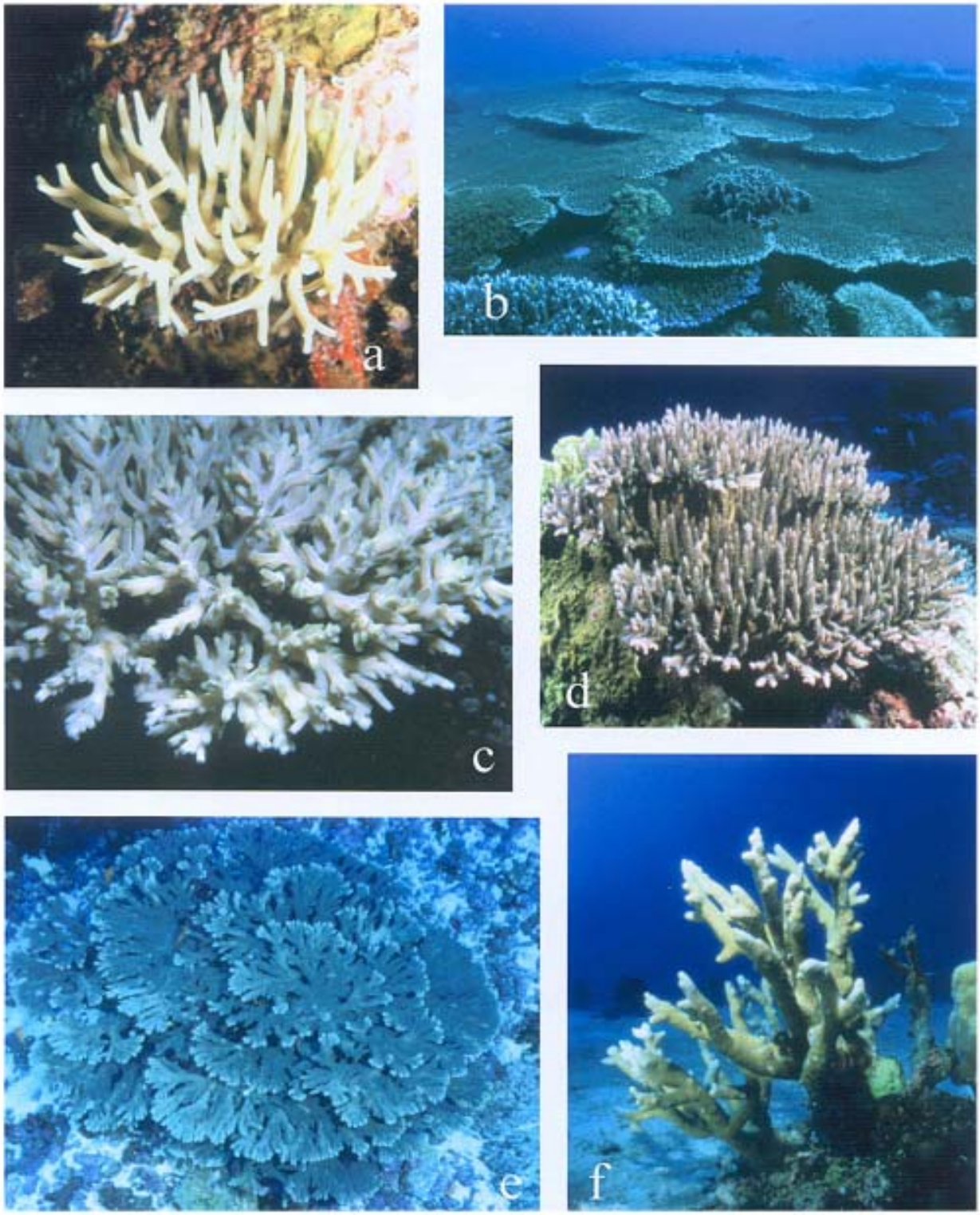


Figure 1: Examples of distinctive Acropora species from Indonesia. (a) A. suharsonoi, a rare species endemic to the Indonesian Archipelago (to date only found on the coasts of Bali and Lombok); (b) A. indonesia, a fragile tabulate species which often forms tiers, occuring throughout the archipelago but rarely documented elsewhere; (c) A. desalwii, a side attached plate which occurs abudantly within the Banda Sea;(d) A. hoeksemai, an arborescent table which occurs in all regions throughout the archipelago except for Sumatra, also occuring in the Western Pacific and East Indian Oceans; (e) A. sukarnoi, a laterally flattened table or plate occuring in Sumatra, Bali and through the Nusa Tenggara region; (f) A. togianensis, a species endemic to the archipelago and restricted to the Togian Islands.

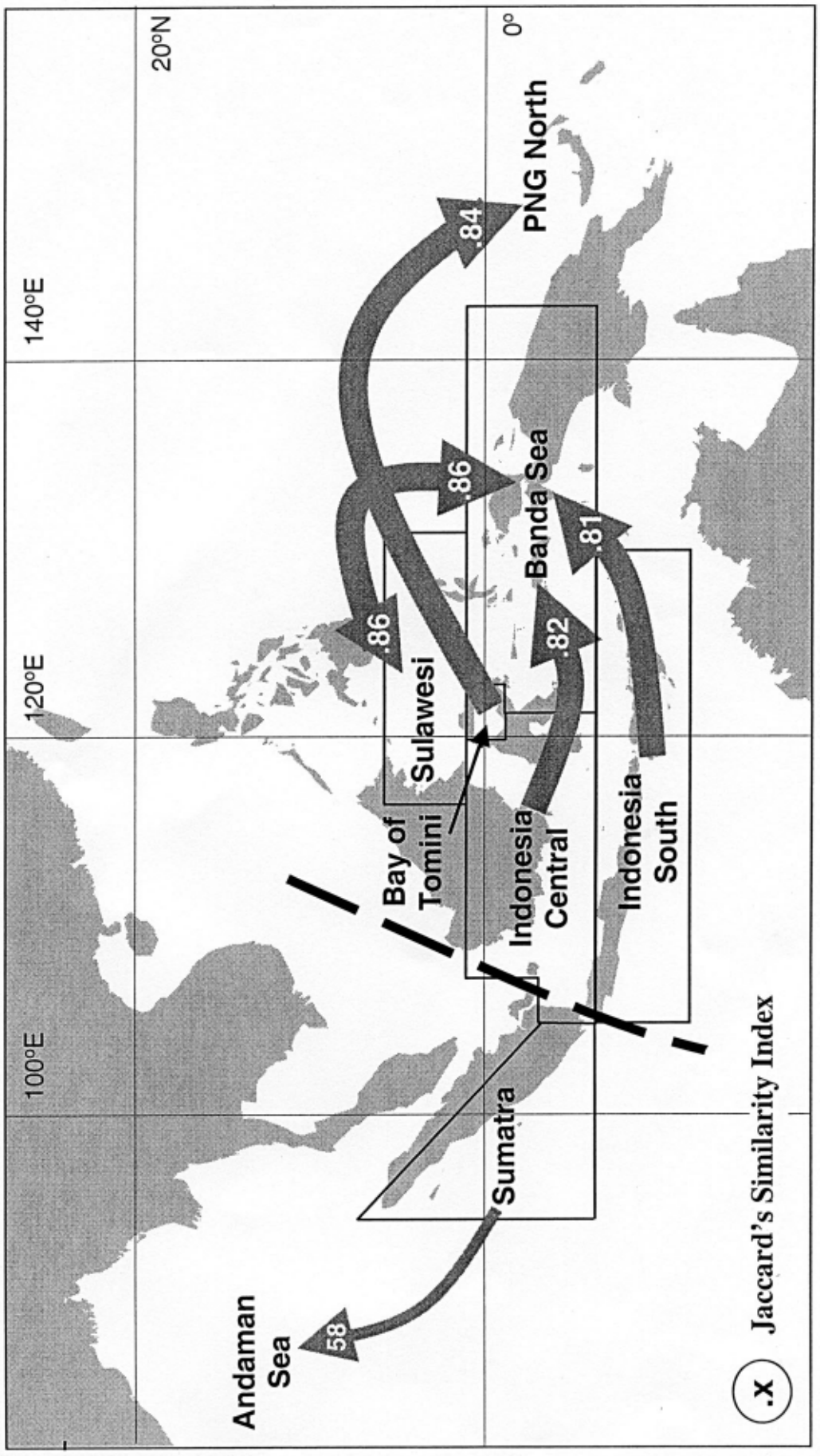


Figure 2. The six geographic regions used to analyse *Acropora* species distributions within Indonesia. An arrow pointing from each region indicates the region (worldwide) to which it is most similar, based on Jaccard's similarity index.

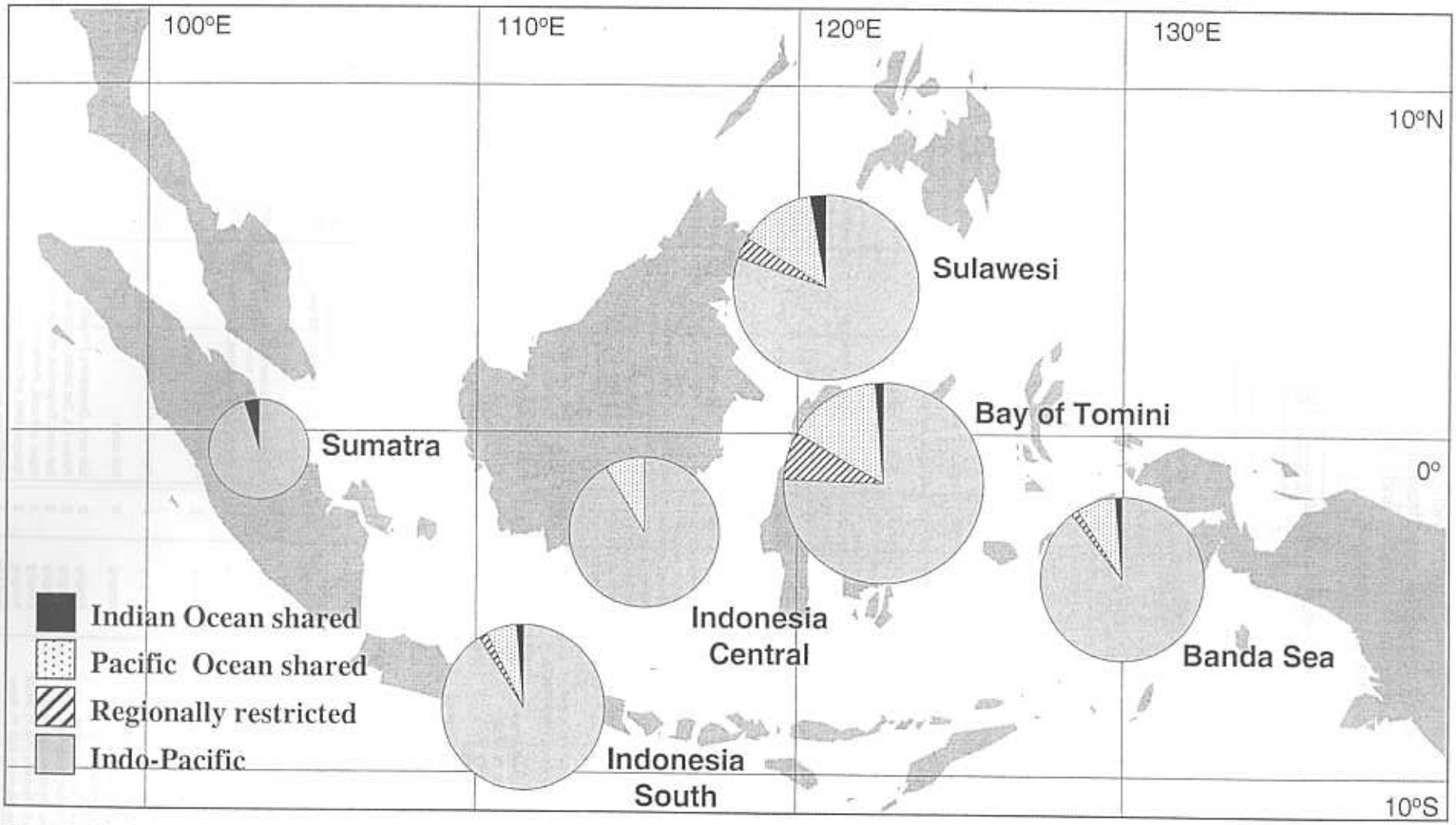


Figure 3. Pie diagrams showing a regional breakdown of Acropora species diversity (proportional to diameter) and the proportion of species from each geographic distribution category, indicated by segment size.

Appendix 1. List of sites from which specimens of Acropora were obtained for this study. Asterisks indicate sites from which specimens were received from other works. The remaining 146 sites were those surveyed for Acropora species composition and habitat features. Abbreviations: (br) branching, (t) table, (p) plate, (m) massive, (b) bottlebrush.

No	Region	Site	Reef Type	Habitat	Dominants	Cover	Impacts	Lat / Long
1	**Sumatra**	W Sumatra, Pl. Pieh Island	Fringing	2	*Montipora* (f), *Acropora,* Pocilloporidae	45%		0°52' / 100°05'
2	**Sumatra**	W Sumatra, Pl. Sauh Island	Coral Cay	2	*Heliopora, Acropora*	85%		0°52' / 100°18'
3	**Sumatra**	W Sumatra, Pl. Sauh Island*						0°56' / 100°14'
4	**Sumatra**	W Sumatra, Pl. Sipakal Island	Submerged Reef	2 & 3	*Acropora, Porites* (t), Pocilloporidae	70%		0°56' / 100°14'
5	**Sumatra**	W Sumatra, Gosong Gedang	Submerged Reef	2	*Acropora* (br), *Montipora* (t)	5%	Dynamiting	1°03' / 100°15'
6	**Sumatra**	W Sumatra, Pl. Sinyaru Island	Coral Cay	2	*Acropora*	70%	Dynamiting/COT	1°04' / 100°17'
7	**Sumatra**	NW Sumatra, Nias Island*						1°05' / 97°30'
8	**Sumatra**	W Sumatra, Pl. Parsumpahan Island	Fringing	2	*Porites* (m,br), sponge (br)	40%		1°07' / 100°21'
9	**Sumatra**	W Sumatra, Pl. Sirandah	Coral Cay	2	*Acropora, Porites* (br), *Echinopora* (p)	80%		1°08' / 100°20'
10	**Sumatra**	NW Sumatra, Nias Island Island*						1°10' / 97°20'
11	**Sumatra**	Sunda Strait, Panaitan Island*						6°36' / 105°12'
12	**Indonesia Central**	WC Sulawesi, Donggala Beach	Fringing	2	*Acropora, Montipora, Porites* (br)	40%		0°39' / 119°44'
13	**Indonesia Central**	WC Sulawesi, Donggala Beach	Shoal	2	Soft Coral, Sponge, *Acropora*			0°40' / 119°45'
14	**Indonesia Central**	WC Sulawesi, Donggala Beach*						0°49' / 119°44'
15	**Indonesia Central**	Pl. Laut, Pemancingan*						3°13' / 116°17'
16	**Indonesia Central**	S Kalimantan, Pl. Laut Island*						3°35' / 116°10'
17	**Indonesia Central**	S Sulawesi, Kapoposan*						4°40' / 118°59'
18	**Indonesia Central**	SW Sulawesi, Pl. Badi Island	Coral Cay/Patch	2	*Acropora, Porites (m), Millepora*			4°58' / 119°17'
19	**Indonesia Central**	Pl. Loemba Loemba	Sand Cay/Patch	2	*Acropora*, Pocilloporidae, *Montipora*			4°58' / 119°12'
20	**Indonesia Central**	SW Sulawesi, Bone Tambung	Patch reef	2	*Acropora*, Fungiids, *Galaxea*			5°01' / 119°13'
21	**Indonesia Central**	S Sulawesi, Barang Lompo*						5°02' / 119°20'
22	**Indonesia Central**	Kudingareng Keke	Sand Cay	2	Algae, *Acropora*	70%	Dynamiting/COT	5°06' / 119°17'
23	**Indonesia Central**	S Sulawesi, Samalona*						5°08' / 119°20'
24	**Indonesia Central**	Seribu Island, Biru Reef	Coral Cay	2	*Acropora,* Soft Corals		siltation	5°37' / 106°35'
25	**Indonesia Central**	Seribu Island, P. Kapas Island*						5°31' / 106°31'
26	**Indonesia Central**	Seribu Island, Pl. Kapas Island*						5°31' / 106°31'
27	**Indonesia Central**	Seribu Island, Pl. Yu Barat Island*						5°33' / 106°31'
28	**Indonesia Central**	Java, Seribu Island, Pl. Malinjo*						5°35' / 106°32'
29	**Indonesia Central**	Seribu Island, Malinjo Reef	Sand Cay	2	*Montipora, Acropora, Turbinaria*	30%	Heavy silt load	5°35' / 106°32'
30	**Indonesia Central**	Seribu Island, Pl. Saktu Island*						5°35' / 106°32'
31	**Indonesia Central**	Seribu Island, Pl. Yu Timur*						5°35' / 106°32'
32	**Indonesia Central**	Karimunjawa, Pl. Kecil*						5°49' / 110°30'
33	**Indonesia Central**	Karimunjawa, Gosong Cemara*						5°50' / 110°30'
34	**Indonesia Central**	Bodgaya Island, Pl. Sipadan Island*						6°00' / 119°00'
35	**Indonesia Central**	Java, Jakarta*						6°09' / 106°49'
36	**Indonesia Central**	Nusa Tenggara, Taka'bonerate*						6°30' / 121°20'
37	**Indonesia Central**	Taka'bonerate*						6°30' / 121°20'
38	**Indonesia Central**	S Sulawesi, Pl. Kayuadi Island*						6°55' / 120°50'
39	**Indonesia South**	Christmas Island, The Cove*						10°02' / 109°36'
40	**Indonesia South**	Timor, Teluk Kupang, Pl. Kera Island	Coral Cay	2	Soft Corals, *Acropora,* Sponges	45%		10°05' / 123°34'
41	**Indonesia South**	Pl. Semau	Fringing	2 & 3	Alcyonacea, Gorgonians, Porites (t)	40%		10°12' / 123°28'
42	**Indonesia South**	W Timor, Kupang, Tenau Harbour*		2	Soft Corals, *Porites* (t)	50%		10°12' / 123°31'
43	**Indonesia South**	Christmas Island, The Cove*						10°2' / 109°36'
44	**Indonesia South**	East Indies*						7°00' / 110°00'
45	**Indonesia South**	Java*						7°00' / 110°00'
46	**Indonesia South**	S Sulawesi, Pl. Panjang Island*						7°05' / 120°25'
47	**Indonesia South**	S Sulawesi, Pl. Tanahjanpea Island*						7°10' / 120°35'
48	**Indonesia South**	Bali, Pulaki*						8°06' / 114°27'
49	**Indonesia South**	NW Bali, Pemuteran Beach	Fringing	2	*Porites* (br), *Acropora, Pachyensis*			8°09' / 114°36'
50	**Indonesia South**	Nusa Tenggara, Pl. Moyo	Patch reef	4	Macroalgae		bleach/dynamite	8°10' / 117°14'
51	**Indonesia South**	Nusa Tenggara, Pl. Moyo	Patch reef	4	Macroalgae		bleach/dynamite	8°10' / 117°40'
52	**Indonesia South**	Alor Island, Pl. Pantar	Fringing	2	*Acropora, Hydnophora*, Algae			8°11' / 124°20'
53	**Indonesia South**	Nusa Tenggara, Pl. Sangeang	Fringing	2	*Acropora*		bleach/dynamite	8°12' / 119°06'
54	**Indonesia South**	Alor Island, Pl. Pantar	Fringing	2	Plating corals, *Seriatopora, Acropora*	30%		8°13' / 124°21'
55	**Indonesia South**	Alor Island, Pl. Reta	Fringing	2	Algae, soft coral, *Montipora*	50%		8°13' / 124°21'
56	**Indonesia South**	Alor Island, Pl. Reta	Fringing	2 & 3	Soft coral, *Halimeda,* Sponge (p)	40%		8°13' / 124°22'
57	**Indonesia South**	Alor Island, Pl. Reta	Fringing	2	Soft coral, Anemones, Algae, Sponge	50%		8°13' / 124°23'
58	**Indonesia South**	Alor Island, Alor	Fringing	2	Soft coral, Algae, *Montipora*	40%		8°15' / 124°24'
59	**Indonesia South**	Alor Island, Alor, Kebola Bay	Fringing	2	Alcyconacea			8°15' / 124°27'
60	**Indonesia South**	Flores, Tg Besi*						8°15' / 120°25'
61	**Indonesia South**	Alor Island, Pl. Kumba	Fringing	2	*Acropora, Seriatopora, Halimeda*	40%		8°16' / 124°24'
62	**Indonesia South**	Alor Island, Pl. Pura	Fringing	2 & 3	Plating corals, Soft corals, Sponges	60%		8°16' / 124°21'
63	**Indonesia South**	Alor Island, Selat Pantar	Patch reef	4	Macroalgae			8°16' / 124°23'
64	**Indonesia South**	Alor Island, Selat Pantar*						8°16' / 124°33'
65	**Indonesia South**	Alor Island, Pl. Pura	Fringing	2 & 3	*Acropora,* Soft corals, Sponges	50%		8°17' / 124°22'
66	**Indonesia South**	Alor Island, Pl. Pura*						8°18' / 124°19'
67	**Indonesia South**	E Bali, Tulamben	Shipwreck	1	Soft corals, *Aglaeophenia,* Sponges	15%		8°18' / 115°38'
68	**Indonesia South**	Alor Island, Pl. Pura*						8°19' / 124°19'
69	**Indonesia South**	HOLOTYPE, Gili Trawangan	Fringing	2	*Porites* (m)			8°20' / 116°01'
70	**Indonesia South**	Alor Island, Alor*						8°20' / 124°23'
71	**Indonesia South**	Alor Island, Pl. Pantar*						8°20' / 124°18'
72	**Indonesia South**	Maumere B. Pamana Kecil	Fringing	3	Alcyonacea, Gorgonians, Sponges	15%	Equake/tidalwav	8°20' / 122°21'
73	**Indonesia South**	Lombok Barat, Teluk Nare*						8°20' / 116°01'
74	**Indonesia South**	Lombok, Gili Meno	Fringing	3	Soft corals		dynamiting	8°20' / 116°03'
75	**Indonesia South**	Lombok, Gili Meno*						8°20' / 116°30'
76	**Indonesia South**	Lombok, Gili Trawangan	Fringing	2	Soft coral, *Seriatopora,* Fungiids			8°20' / 116°01'
77	**Indonesia South**	Lombok, Gili Trawangan	Fringing	2	*Porites* (m), Soft corals, *Acropora*	60% - 100%		8°20' / 116°03'
78	**Indonesia South**	Flores, Maumere Bay, Pl. Babi	Fringing	3	Soft coral, Gorgonians, sponge (br)	45%	Equake/tidalwav	8°24' / 122°30'
79	**Indonesia South**	Flores, Maumere Bay, Pl. Besar	Fringing	3	Algae, soft coral, *Porites* (br)	15%	Equake/tidalwav	8°27' / 122°20'
80	**Indonesia South**	Flores, Maumere Bay, Pl. Besar	Fringing	3	Sponges (br/t), soft corals, *Acropora*	40%		8°29' / 122°21'
81	**Indonesia South**	Maumere Bay, Pl. Pangalatang	Sand Cay	2	Alcyonacea, Sponge, *Porites* (br)	20%	Equake/tidalwav	8°29' / 122°28'
82	**Indonesia South**	Lombok*						8°29' / 116°40'
83	**Indonesia South**	Maumere Bay, Kojadoi Reef*						8°30' / 122°24'
84	**Indonesia South**	Lomblen*						8°31' / 123°29'

No	Region	Site	Reef Type	Habitat	Dominants	Cover	Impacts	Lat / Long
85	**Indonesia South**	Tukangbesi Island, Hoga Island*						8°31' / 123°29'
86	**Indonesia South**	Tukangbesi Island, Kapota Island*						8°31' / 123°29'
87	**Indonesia South**	Maumere Bay, Wailiti Reef	Submerged	2 & 3	Soft coral, Algae	35%		8°32' / 122°10'
88	**Indonesia South**	Maumere Bay, Waipare Village	Fringing	2 & 3	Algae, soft corals, sponges	<2%	Equake/tidalwav	8°37' / 122°14'
89	**Indonesia South**	Nusa Tenggara, Pl. Komodo	Fringing	2	Macroalgae			8°37' / 119°20'
90	**Indonesia South**	Bali, Nusa Lembongan	Fringing	2 & 4	Soft coral, *Seriatopora, Acropora*	40%		8°40' / 115°26'
91	**Indonesia South**	Nusa Lembongan, Lembongan	Fringing	4	*Acropora*			8°40' / 115°25'
92	**Indonesia South**	Nusa Penida, Sekolah Dasar	Fringing	2	*Acropora*, soft corals, sponges	80%		8°40' / 115°30'
93	**Sulawesi Sea**	N Sulawesi, Tg Dodepo	Fringing	2	*Porites* (br), sponges, soft coral	50%		0°20' / 123°55'
94	**Sulawesi Sea**	N Sulawesi, Malibagu	Fringing	2	Algae, *Acropora*		dynamiting	0°21' / 124°3'
95	**Sulawesi Sea**	N Sulawesi, Palau Pondang	Fringing	4	Caulerpa, Acropora, Galaxea		dynamiting	0°27' / 124°28'
96	**Sulawesi Sea**	Tg Flesko, Batu Mandi	Pinnacles	2 & 3	Soft coral, hydroids, sponges	20%		0°28' / 124°31'
97	**Sulawesi Sea**	N Sulawesi, Pl. Batong	Rocky		Soft corals			0°43' / 124°38'
98	**Sulawesi Sea**	C Molucca Sea, Mayu Island	Fringing/rocky	2	Soft corals, *Aglaeophorea, Millepora*	30%		1°16' / 126°24'
99	**Sulawesi Sea**	N Sulawesi	Fringing	3	Porifera			1°18' / 124°51'
100	**Sulawesi Sea**	N Sulawesi, Siladen Island	Fringing	3	*Acropora*			1°18' / 124°51'
101	**Sulawesi Sea**	C Molucca Sea, Mayu Island	Fringing	2	*Acropora, Astreopora*, Soft corals	60%		1°20' / 126°25'
102	**Sulawesi Sea**	Lembeh Strait, NW Lembeh I	Fringing	2	Soft coral, *Euphyllia, Lobophyllia*	10%	Volcanic sand	1°28' / 125°14'
103	**Sulawesi Sea**	Lembeh Strait, Batu Angus	Submerged	2	*Echinopora, Echinophyllia, Montipora*	90%		1°29' / 125°14'
104	**Sulawesi Sea**	Lembeh Strait, Batu Angus	Submerged	4	*Montipora, Echinopora, Anacropora*	80-90%	Volcanic (120y)	1°29' / 125°14'
105	**Sulawesi Sea**	N Sulawesi, Bunaken Island*						1°30' / 125°00'
106	**Sulawesi Sea**	Lembeh Strait, NW Lembeh I	Fringing	3	Soft coral, sponges	2%		1°31' / 125°16'
107	**Sulawesi Sea**	NW Sulawesi, Tg Pisok	Fringing	2	Soft corals, *Montipora, Porites* (br)	70%		1°34' / 124°47'
108	**Sulawesi Sea**	N Sulawesi, Bunaken Island	Fringing	3	Alglaeophania, Soft corals, Sponges	70%		1°36' / 124°45'
109	**Sulawesi Sea**	N Sulawesi, Bunaken Island	Fringing	3	Sponges, *Millepora*	30%		1°37' / 124°44'
110	**Sulawesi Sea**	N Sulawesi, Bunaken Island	Fringing	3		30%		1°37' / 124°45'
111	**Sulawesi Sea**	N Sulawesi, Nain Island	Fringing	2	*Acropora, Porites* (br), Soft corals			1°37' / 124°45'
112	**Sulawesi Sea**	N Sulawesi, Bunaken Island	Fringing	3				1°38' / 124°45'
113	**Sulawesi Sea**	N Sulawesi, Manadotua Island	Fringing	3	Sponges, *Aglaephanea, Porites* (br)	20%		1°38' / 124°43'
114	**Sulawesi Sea**	N Loloda Island, Sidanga I*						1°39' / 127°29'
115	**Sulawesi Sea**	S Loloda Island, Sidanga I	Fringing	2	Soft corals, *Porites*	30%		1°39' / 127°28'
116	**Sulawesi Sea**	S Loloda Island, Sidanga I	Fringing	3	*Acropora* (b), *Anacropora, Montipora*	90%		1°39' / 127°29'
117	**Sulawesi Sea**	S Loloda Island, Kahatola I	Fringing	2	Soft corals, *Seriatopora, Montipora*	10%		1°42' / 127°30'
118	**Sulawesi Sea**	S Loloda Island, Kahatola I	Fringing	2	Soft corals, *Acropora, Porites*	40%	Volc. /Equake	1°42' / 127°31'
119	**Sulawesi Sea**	N Sulawesi, Tg Pulisan	Fringing	2	Soft corals, Pocilloporidae, *Acropora*			1°42' / 125°09'
120	**Sulawesi Sea**	S Loloda Island, Kahatola I	Fringing/rocky	3	Soft corals, Hydroids, *Porites*	5%		1°44' / 127°30'
121	**Sulawesi Sea**	S Loloda Island, Kahatola I*						1°44' / 127°30'
122	**Sulawesi Sea**	N Sulawesi, Bangka Island	Submerged	4	Soft corals, *Acropora, Goniopora*			1°45' / 125°09'
123	**Sulawesi Sea**	N Sulawesi, Pl. Sahaong	Rocky		Soft corals, *Dendrophyllia, Acropora*			1°45' / 125°10'
124	**Sulawesi Sea**	N Sulawesi, Tg Torowitang	Fringing	3	Soft corals, *Acropora, Porites* (br)			1°45' / 124°59'
125	**Sulawesi Sea**	N Sulawesi, Tg Torowitang*						1°45' / 124°59'
126	**Sulawesi Sea**	N Sulawesi, Nain Island	Fringing	4	*Acropora, Anacropora, Porites*			1°46' / 124°48'
127	**Sulawesi Sea**	N Halmahera, Gorolamo Island	Fringing	2	Whips, sponges, Soft corals	15%		1°48' / 127°36'
128	**Sulawesi Sea**	NW Halmahera, Tg Boro	Fringing	2	Aglaeophaenia, sponges, soft coral			1°57' / 127°42'
129	**Sulawesi Sea**	E. Kalimantan, Sangalaki Island	sand cay	2	*Pachyseris, Coscenarea, Acropora*			2°05' / 118°24'
130	**Sulawesi Sea**	E. Kalimantan, Sangalaki Island	sand cay	4	*Acropora,* soft corals, sponges			2°06' / 118°24'
131	**Sulawesi Sea**	Sangihe Island, Biaro Island	Fringing	2	Soft corals, *Porites* (m), *Millepora*	60%		2°06' / 125°20'
132	**Sulawesi Sea**	Sangihe Island, Biaro Island	Fringing	2	*Montipora, Acropora, Heliopora*	80%		2°07' / 125°20'
133	**Sulawesi Sea**	E. Kalimantan, Kakaban Island	Fringing	3	*Acropora,* sponges (br), *Montipora*			2°08' / 118°30'
134	**Sulawesi Sea**	E. Kalimantan, Kakaban Island	Fringing	3	*Acropora,* sponges (br), *Montipora*			2°08' / 118°31'
135	**Sulawesi Sea**	N Loloda Island, Salangadeke I	Submerged	4	*Acropora, Porites, Pocillopora*	70%		2°08' / 127°44'
136	**Sulawesi Sea**	N Loloda Island, Dagasuli I	Submerged	4	*Acropora* (b), Soft corals, *Millepora*	80%		2°10' / 127°45'
137	**Sulawesi Sea**	N Loloda Island, Deherete I	Fringing/rocky	2 & 3	Soft corals, Gorgonians, *Millepora*	40%		2°10' / 127°45'
138	**Sulawesi Sea**	N Loloda Island, Doi Island	Fringing	2	*Acropora,* soft corals, sponges			2°15' / 127°45'
139	**Sulawesi Sea**	Karang Masimbung	Sand cay	2 & 3	*Montipora, Porites*, Soft Corals			2°16' / 118°16'
140	**Sulawesi Sea**	Karang Tababinga	Fringing	2	*Acropora, Millepora,* Soft corals			2°16' / 118°14'
141	**Sulawesi Sea**	N Loloda Island, Deherete I*						2°16' / 127°44'
142	**Sulawesi Sea**	N Loloda Island, Dagasuli I	Submerged	4	*Acropora* (b), *Montipora*	95%		2°16' / 127°45'
143	**Sulawesi Sea**	N Loloda Island, Deherete I*						2°16' / 127°44'
144	**Sulawesi Sea**	E. Kalimantan, Derawan Island	Coral cay	2	*Montipora, Millepora, Acropora*		flood runoff	2°17' / 118°14'
145	**Sulawesi Sea**	Sangihe Island, Ruang Island	Volcanic Ash	1	Sponges, Pocilloporidae, Faviids			2°17' / 125°21'
146	**Sulawesi Sea**	E. Kalimantan, Derawan Island	Coral	4	*Acropora,* Pocilloporidae, *Millepora*	75%		2°18' / 118°15'
147	**Sulawesi Sea**	N Loloda Island, Doi Island*						2°18' / 127°45'
148	**Sulawesi Sea**	Sangihe Island, Ruang Island	Volcanic Ash	1	*Acropora,* Euphyliidae, *Porites* (br)	90%		2°19' / 125°23'
149	**Sulawesi Sea**	E Kalimantan, K. Panjang*						2°20' / 118°14'
150	**Sulawesi Sea**	E. Kalimantan, Panjang Island	sand cay	2 & 3	*Acropora*, Pocilloporidae, Soft corals			2°20' / 118°14'
151	**Sulawesi Sea**	Sangihe Island, Makalehi Island	Fringing	1	Soft Corals, *Acropora,* Sponges	40%		2°45' / 125°09'
152	**Sulawesi Sea**	Sangihe Island, Siau Island	Fringing	1	*Acropora, Seriatopora*, Soft corals	30- 80%		2°49' / 125°24'
153	**Sulawesi Sea**	Sangihe Island, Mahangetang I	Volcanic Rock	1	*Acropora*, Pocilloporidae, *Millepora*	30 - 80%		3°09' / 125°26'
154	**Sulawesi Sea**	Sangihe Island, Mahangetang I	Deep reef flat	1	*Acropora, Millepora*			3°10' / 125°27'
155	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°34' / 118°46'
156	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°34' / 118°45'
157	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°34' / 118°46'
158	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°35' / 118°43'
159	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°35' / 118°43'
160	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°35' / 118°45'
161	**Sulawesi Sea**	Bodgaya Island, Pl. Tetagan*						4°35' / 118°43'
162	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°36' / 118°46'
163	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°36' / 118°43'
164	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°36' / 118°46'
165	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°37' / 118°38'
166	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°37' / 118°38'
167	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°38' / 118°47'
168	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°38' / 118°48'

Appendix 1. Continued

No	Region	Site	Reef Type	Habitat	Dominants	Cover	Impacts	Lat / Long
169	**Sulawesi Sea**	Sabah, Bodgaya Island *						4°39' / 118°39'
170	**Sulawesi Sea**	Sabah, Bodgaya Island *						4°39' / 118°46'
171	**Sulawesi Sea**	Sabah, Bodgaya Island*						4°40' / 118°38'
172	**Sulawesi Sea**	Sabah, Bodgaya Island *						4°40' / 118°38'
173	**Bay Tomini**	Togian Islands, WaleaBahi Island	Fringing	2				0°12' / 122°14'
174	**Bay Tomini**	Togian Islands, Tg Komali	Submerged	2 & 4	*Acropora,* Soft Coral, *Seriatopora*	60%		0°12' / 122°14'
175	**Bay Tomini**	Togian Islands, S. of P. Talawanga	Submerged	2				0°18' / 121°58'
176	**Bay Tomini**	Togian Island	Fringing	2	*Porites* (br), Lobophylia, *Seriatopora*	30%	Dynamiting	0°20' / 121°49'
177	**Bay Tomini**	Togian Islands, S. of P. Tongkabul*						0°20' / 121°59'
178	**Bay Tomini**	Togian Islands, E. of P. Pangempang	Fringing	4	Seagrass, *Acropora*			0°20' / 121°55'
179	**Bay Tomini**	Togian Islands, West of P. Tengah	Fringing	2 & 4				0°21' / 121°30'
180	**Bay Tomini**	Togian Islands, West of P. Tengah	Fringing	2				0°23' / 122°0'
181	**Bay Tomini**	Togian Islands, Walea Lighthouse	Coral Cay	2				0°24' / 122°26'
182	**Bay Tomini**	Togian Islands, E. of Tg. Balikapata	Patch	3 & 4	*Porites* (br), *Pocillipor*a			0°25' / 121°40'
183	**Bay Tomini**	Togian Islands, South of Tel. Togian	Patch	2				0°25' / 122°0'
184	**Bay Tomini**	Togian Islands, Dondola Island	Sand Cay	3	Soft corals, tube sponges			0°25' / 122°38'
185	**Bay Tomini**	Togian Islands, Walea Lighthouse	Fringing	2				0°25' / 122°25'
186	**Bay Tomini**	Togian Islands, M.A.Ridge	Patch reef	2		70%		0°26' / 122°15'
187	**Bay Tomini**	Togian Islands, Pasir Tengah	Submerged	3 & 4	*Porites, Acropora, Seriatopora*			0°26' / 121°37'
188	**Bay Tomini**	Togian Islands, Talatakoh Island	Fringing	2	*Porites, Acropora,* Sponges (br)			0°26' / 122°05'
189	**Bay Tomini**	Togian Islands, Talatakoh Island	Fringing	2 & 4				0°26' / 122°6'
190	**Bay Tomini**	Togian Islands, Stick Stuck Reef	Patch reef	4				0°27' / 122°4'
191	**Bay Tomini**	Togian Islands, Pl. Sendiri	Sand Cay	2 & 4	*Acropora, Montipora,* Sponges	50%	Dynamiting	0°28' / 122°56'
192	**Bay Tomini**	Togian Islands, Talatakoh Island	Submerged	2 & 4				0°28' / 122°04'
193	**Bay Tomini**	Togian Islands, Outer Barrier	Barrier	3				0°29' / 122°4'
194	**Bay Tomini**	Togian Islands, Bangu Island	Submerged	2 & 4	*Acropora, Montipora*, sponges (br)			0°30' / 122°30'
195	**Bay Tomini**	Togian Islands, Batudaka Island	Fringing	2	*Porites, Acropora, Montipora*			0°33' / 121°53'
196	**Bay Tomini**	Togian Islands, Hut Reef	Patch	3				0°35' / 121°41'
197	**Bay Tomini**	Togian Islands, Pl. Taupan	Fringing	3	*Montipora,* soft corals, sponges			0°35' / 121°37'
198	**Bay Tomini**	Togian Islands, Tanjung Taupan	Fringing	3				0°35' / 121°37'
199	**Banda Sea**	Halmahera Sea, Gebe Island*						0°00' / 129°23'
200	**Banda Sea**	Halmahera Sea, Gebe Island*						0°02' / 129°23'
201	**Banda Sea**	Halmahera Sea, Gebe Island*						0°05' / 129°25'
202	**Banda Sea**	Halmahera Sea, Gebe Island*						0°07' / 129°26'
203	**Banda Sea**	Halmahera Sea, Gebe Island*						0°07' / 129°29'
204	**Banda Sea**	Halmahera Sea, Gebe Island*						0°11' / 129°30'
205	**Banda Sea**	Halmahera Sea, Gebe Island*						0°12' / 129°34'
206	**Banda Sea**	Sambai St, Bacan Island*						0°19' / 127°16'
207	**Banda Sea**	Halmahera Sea, Gag Island*						0°24' / 129°54'
208	**Banda Sea**	Halmahera Sea, Gag Island*						0°25' / 129°56'
209	**Banda Sea**	Halmahera Sea, Gag Island*						0°26' / 129°56'
210	**Banda Sea**	Halmahera Sea, Gag Island*						0°27' / 129°51'
211	**Banda Sea**	Halmahera Sea, Gag Island*						0°27' / 129°54'
212	**Banda Sea**	Halmahera Sea, Gag Island*						0°27' / 129°55'
213	**Banda Sea**	Halmahera Sea, Gag Island*						0°28' / 129°54'
214	**Banda Sea**	Halmahera Sea, Gag Island*						0°29' / 129°53'
215	**Banda Sea**	Batanta I., Warwarai Bay*						0°49' / 130°29'
216	**Banda Sea**	C Molucca Sea, Tifore I	Submerged	4	Softcorals, *Montipora, Porites*	50%		0°57' / 126°08'
217	**Banda Sea**	Tifore I, Tg Obi Obi	Fringing/rocky	2	Soft corals, *Turbinaria, Montipora*	30%		0°58' / 126°07'
218	**Banda Sea**	Banggai Island, Makailu Island	Fringing	3	*Montipora,* Sponges, Soft corals	30%	Dynamiting	1°19' / 122°44'
219	**Banda Sea**	Ambon, Tanjung Setan*						3°19' / 128°20'
220	**Banda Sea**	Ambon, Pombo Island*						3°30' / 128°35'
221	**Banda Sea**	Ambon*						3°35' / 128°20'
222	**Banda Sea**	Ambon*						3°35' / 128°20'
223	**Banda Sea**	Ambon, Hila*						3°35' / 128°07'
224	**Banda Sea**	Ambon, Wailiha*						3°38' / 128°24'
225	**Banda Sea**	NW Nusa Laut, Nalahia Bay	Patch	2	*Aglaeophenia, Acropora*			3°40' / 128°45'
226	**Banda Sea**	Haruku Island, Oma*						3°40' / 128°35'
227	**Banda Sea**	NW Nusa Laut, Nalahia Bay*						3°40' / 128°45'
228	**Banda Sea**	Ambon, Wayame*						3°41' / 128°06'
229	**Banda Sea**	Ambon Island, Hukurila Beach	Fringing/rocky	2	Soft corals, *Acropora*			3°45' / 128°15'
230	**Banda Sea**	Ambon, Namalatu Beach*						3°55' / 128°10'
231	**Banda Sea**	Manukang (Suanggi) Island	Fringing	2	Soft Corals, *Galaxea, Porites* (br)			4°19' / 130°42'
232	**Banda Sea**	Banda Island, Gunung Api	Fringing	1	*Acropora*		1988 Eruption	4°31' / 129°52'
233	**Banda Sea**	Banda Island, Ai Island	Fringing	2				4°31' / 129°46'
234	**Banda Sea**	Banda Island, Gunung Api	Fringing	1	*Acropora*		1988 Eruption	4°31' / 129°52'
235	**Banda Sea**	Banda Island, Run Island	Fringing	3	Soft corals, *Acropora*			4°33' / 129°40'
236	**Banda Sea**	Tukangbesi Island, Kapota Island	Fringing	2 & 3	*Porites* (br)			5°10' / 123°35'
237	**Banda Sea**	Lucipara Island, Bingkudu I	Fringing	3	*Acropora, Porites*			5°20' / 127°46'
238	**Banda Sea**	Lucipara Island, Ayam I	Fringing	3	*Tubipora, Porites* (br), *Echinopora*			5°21' / 127°45'
239	**Banda Sea**	Lucipara Island, Mai Island	Fringing	3				5°24' / 127°46'
240	**Banda Sea**	Tukangbesi Island, Hoga Island*						5°26' / 123°48'
241	**Banda Sea**	Lucipara Island	Fringing	2 & 3	*Porites* (br), *Acropora,* sponges			5°28' / 127°31'
242	**Banda Sea**	Manuk Island	Fringing	2	*Euphyllia, Galaxea, Goniastrea*			5°33' / 130°18'
243	**Banda Sea**	Sekaro (Turtle) Island	Atoll	3	*Acropora,* Soft Coral			5°35' / 127°28'
244	**Banda Sea**	Tukanbesi Island, Kaledupa Island*						5°35' / 123°45'
245	**Banda Sea**	Tukangbesi Island, Kaledupa Island*						5°35' / 123°45'
246	**Banda Sea**	Banda Sea*						6°00' / 130°00'
247	**Banda Sea**	Takangbesi Island, Moromaho Island*						6°08' / 124°38'
248	**Banda Sea**	Tukangbesi Island, Moromaho Island*						6°08' / 124°38'
249	**Banda Sea**	Serua Island	Fringing	1	*Porites*		Active volcano	6°19' / 130°01'
250	**Banda Sea**	Nil Desperandum Reef*						6°36' / 129°47'

Appendix 1. Continued

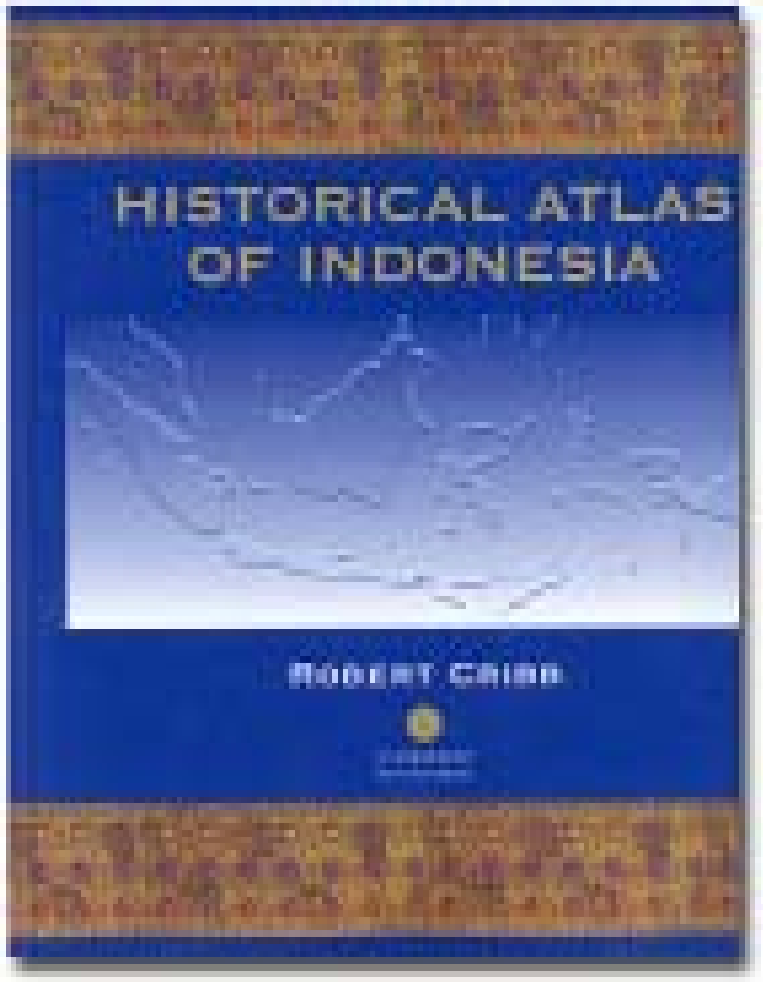
Robert Cribb (2000) Historical Atlas of Indonesia, Curzon Press, London, 256pp, ISBN 0-7007-0985-1; RRP S$75.

RESENSI BUKU
BOOK REVIEW

Historical Atlas of Indonesia – WOW!

Did you know that:

- The Indonesian archipelago has 76 islands (including West Papua) which are larger than 500 km^2 in size – to give some idea of scale, Batam (at 470 km^2 does not make the list, while Komodo, at 520 km^2 just scrapes in);
- The capital of South Sulawesi which was recently changed back to Makassar has also been known as Ujung Pandang, Makasar, Macassar and Mengakasar; the confusion over place names in Indonesia is long standing - only since 1973 has the standardization of language enabled place names to be fixed;
- Until as recently as the mid 1970s, Javanese tigers still roamed small forests within 120 kms of Jakarta;
- Before the adoption of Malay (or bahasa Indonesian) as the future state language of Indonesia in 1928 there were more than 250 Austronesian and more than 150 Papuan (or Melanesian) languages spoken.; many of these have now been lost, but some 13 languages now have >one million speakers (the top five after bahasa Indonesian are Javanese, Malay, Sundanese, Madurese and Minangkabau);
- Migration, whether forced or spontaneous, is a key factor in the historical development of each island in Indonesia; people who have been the least likely to move to other provinces include people born in Irian Jaya, West, Central and South Kalimantan, Lampung, NTB and NTT;
- There have been many changes in governance over the past two millennia, reflecting successions of local and colonial rulers and the wax and wane of their empires; the most rapid change in governance occurred in 1942 – from the first landing in Java of Japanese forces to formal surrender took only 7 days!



These are just some of the literally thousands of facts and ideas that emerge from a quick read of this amazing new Atlas by Robert Cribb from the University of Queensland. Actually, to describe this work and these facts with mere words does not do justice to the work as most of the information gathered by Cribb is presented in primarily map form.

The resultant collection is undoubtedly the finest collection of thematic maps of the Indonesian and Malay archipelagos that has ever been assembled. Interestingly, Cribb draws together the four States of Indonesia, Malaysia, Singapore and Brunei as the boundaries for this Atlas and de-

fends this choice by noting their political, historical, economic, biological and physical linkages. He presents a cogent argument that in order to understand modern Indonesia, one must understand the historical geography of the country and broader archipelago.

The resulting analyses will surprise most Indonesians, particularly those whose "world view" has been limited to the often inaccurate and badly out-of-date reference works available in Indonesian. Indeed, it is a sad commentary on the state of the disciplines of geography and history and of the state of scholarship in Indonesia in general that this work was produced by a foreign academic with little direct involvement from Indonesian academics and institutions. Most of the source material was derived from readily available published works, with information on the colonial era drawn from Dutch libraries.

Perhaps the only substantive criticism is that there is an uneven treatment of time horizons for analysis: political data are, for example, reported up until the 1999 elections, while other data cover periods up until the 1980s only. There is also clearly scope for an elaboration of various thematic sections (e.g. marine themes receive scant coverage).

Clearly an Indonesian version of this volume would be of considerable benefit to all University students of geography, politics, economics, history, religion and philosophy. However, as Cribb so readily admits, great caution must be exercised when interpreting historical information using maps as the medium of communication. In the didactic teaching regime of most Indonesian education centers it is too easy to accept lines on a map as being more "real" or accurate than they were ever intended to be! He cautions readers that "The aim of this atlas… has been to let the reader see how the different elements of what we now identify as Indonesia gradually assembled, not to imply that there was some teleological necessity in the precise pattern they took".

He succeeds admirably in meeting this broad aim. Indeed this is a work that will be of interest to the general reader as well as the specialist. Perhaps most insightfully, he notes that "Few maps have a beginning and an ending in the manner of prose passages: they demand instead to be explored, pored over, and revisited in a way that prose does not".

I expect that this is a book that will be pored over by many visitors to, and students of, Indonesia. My fervent hope is that some visionary Indonesian author will now collaborate with Cribb to reproduce (or ideally extend) the work in bahasa Indonesian.

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Jane Jacobs (2000) The Nature of Economies, Modern Library Original Random House, New York 2000, 190 pages, Hardcover, $21.95

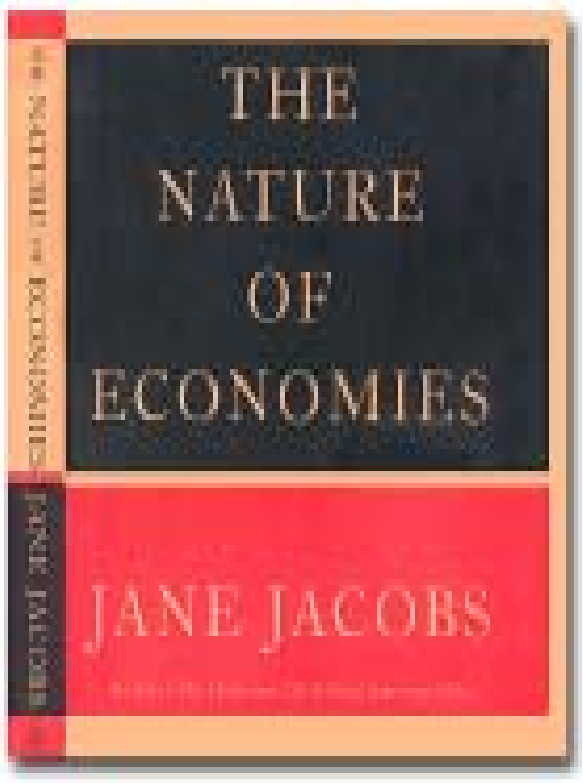
RESENSI BUKU
BOOK REVIEW

The Nature of Economies

In a recent written exam I took, and for sure was the hardest I ever had, I was challenged by a fundamental question about the relationship between ecology and economy. The question centered on the underlying failure of the theory of sustainable development, which by nature seeks to optimize two or more variables simultaneously. The question argues that one of the reasons for the failure of sustainable development is that the social or economic concerns inevitably dominate ecological concerns. How could this basic issue be answered? When sustainable development as a concept first surfaced, the meaning of development obviously needed to be defined. But how?

Jane Jacobs' book, The Nature of Economies provides an interesting answer to questions on the topic of sustainable development with an attempt to evaluate the two systems with a system approach, then to look at the connections between economy and nature (i.e. ecology). The book argues that the principles of development that are common to both systems are the proper subject of economic study. The book is written in the form of a friendly dialogue among five New Yorkers. The question they discuss is does economic life obey the same rules as those leading the system in nature? The book has eight short chapters. The first and the last were introduction and an epilogue, respectively. They cover the nature of development, expansion, self-refueling, the double nature of fitness for survival, the evading collapse, and the unpredictability of the systems.

To me, the book is interesting as it gives me a new angle or new lens to look at both systems. For example, under the topic of system expansion, the five New Yorkers discuss: can the way field and forest maximize their intakes and uses of sunlight teach us something about how economies expand wealth and jobs and can do this in environmentally beneficial ways? The underlying question is both simple and philosophical, and the answers that emerge will shape the way people think about how economies really work. Jacobs gathered information on describing natural processes and selecting examples to illustrate them in a very captivating way. She extracts information that covers fields of biology, evolutionary theory, ecology, geology, meteorology, and other natural sciences as they are understood and interpreted generally in respective sciences. The very last section of the book provides notes on this information, which I think is a useful reference.



If you are in a planning or geography field of study, you must have came across other Jacobs's work as she wrote the legendary The Death and Life of Great American Cities. Jacobs has accomplished another great essay in a difficult topic. She challenges some of established principles of economics in a style that mesmerizes the general audience.

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Jurnal PESISIR & LAUTAN

Indonesian Journal of Coastal and Marine Resources

Tujuan

- Meningkatkan kepedulian masyarakat luas terhadap manfaat dari pengelolaan sumberdaya pesisir dan lautan secara terpadu.
- Merangsang dialog di antara para praktisi dan pakar pengelolaan sumberdaya pesisir dan lautan.
- Membagi pengalaman dan pengetahuan di antara seluruh pemerhati masalah-masalah pengelolaan sumberdaya pesisir dan lautan.

Ruang Lingkup

Teknis, hukum, politik, sosial dan kebijakan yang berkaitan dengan pengelolaan sumberdaya pesisir dan lautan.

Sasaran Pembaca

Pejabat pemerintah dari seluruh tingkatan, kalangan akademik, para peneliti dan praktisi, serta berbagai kalangan pemerhati masalah-masalah pengelolaan sumberdaya pesisir dan lautan.

Format

- Makalah penelitian dan kajian kebijakan (tidak lebih dari 3.000 kata).
- Laporan singkat (menggunakan data yang lebih terbatas dan tidak lebih dari 1.500 kata).
- Artikel kajian (tidak lebih dari 8.000 kata).
- Komentar (opini tentang naskah yang telah diterbitkan dan berbagai macam isu lain yang sesuai dengan ruang lingkup jurnal, tidak lebih dari 1.000 kata).
- Resensi Buku.

Objectives

- Increase public's awareness of the benefits of integrated coastal and marine resources management.
- Stimulate dialogue between practitioners and scientific community.
- Share experience and learn lessons within the coastal and marine management community.

Scope

Technical, legal, political, social and policy that related to the management of coastal and marine resources.

Target Audience

Government officials at all levels, academics, researchers and practitioners involved in discipline of coastal and marine resources management.

Format

- Research and policy review papers (up to 3,000 words).
- Research notes (usually based upon more limited set of data and not exceeding 1,500 words).
- Topic review articles (not more than 8,000 words).
- Comments (opinions relating to previously published material and all issues relevant to the journal's objectives, not more than 1,000 words).
- Book review.

Daftar Isi
Contents

Makalah Penelitian dan Kajian Kebijakan (*Research and Policy Review Paper*)

RESENSI BUKU (*BOOK REVIEW*)

This Journal is produced with the Sponsorship Support of Proyek Pesisir the USAID Coastal Resources Management Project which is implemented via The Coastal Resources Center of the University of Rhode Island