Cont'n. **Table 61**

| VARIETY | YEAR RELEASED | YIELD (mt/ha) | GROWTH DURATION (days) |
|---|---|---|---|
| UPL Cu-2 (UPL Cu 73-21 or Filipina) | 1976 | | 35-40 |
| Explorer | 1980 | 10.92-21.67 | 34 |
| UPL Cub (Pilmaria) | 1984 | 26.5-27.48 | 40 |
| Panorama | 1984 | 33.62 | 39-49 |
| Fiury Hybrid | 1987 | 13.6-17.03 | 38-40 |
| Cumomite | 1987 | 13.88-17.05 | 38-40 |
| **HOT PEPPER** | | | |
| Maniccis | 1984 | 7.48-8.1 | 60-80 |
| **CHINESE CABBAGE** | | | |
| Esperanza | 1982 | | 52 |
| BPI Vgch-1 (Reyna Elena) | 1983 | | 43-44 |
| **LETTUCE** | | | |
| Great Lakes | 1970 | | |
| Balck seeded Simpson | 1970 | | |
| **CABBAGE** | | | |
| KK (F1KK cross) | 1970 | 15-20 | 58-64 |
| KY (F1KY cross) | 1970 | 15-20 | 58-64 |
| **SQUASH** | | | |
| BPI Golden Squash | 1976 | 70-80 | 75-80 |
| Aromca | 1976 | 60-70 | 95-100 |
| **WATERMELON** | | | |
| Sugarbaby | 1976 | 20-25 | 85-96 |
| Charleston Gray | 1976 | | 80-93 |
| Tender Sweet Orange | 1976 | | 85-96 |
| **MUSKMELON** | | | |
| Dulce | 1976 | 15-20 | 70-80 |
| Tam Dew | 1976 | 20-25 | 90-100 |
| **PEPPER** | | | |
| Yolo Wonder | 1972 | | 90-100 |
| California Wonder | 1972 | | |
| All season | 1972 | | |
| **AROID (GABI)** | | | |
| VISCA G-1 (PRG-068) | 1989 | 9.56 | 8 mos |
| PSB VG-2 (Iniito) | 1993 | 6.74 | 8 mos |
| PSB VG-3 | 1993 | 8.9 | 8 mos |
| **CASSAVA** | | | |
| UPL Cv 1 (Datu 1) | 1980 | 40 | 10 mos |
| UPL Cv 2 (Lakan 1) | 1980 | 30 | 10 mos |
| V Cv-1 | 1986 | 40.8 | 238 |
| UPL Cv-3 (Sultan 1) | 1986 | 55.9 | |
| V Cv-2 (CMC 40) | 1988 | 28.4 | |
| V Cv-4 | 1988 | 28 | |
| UPL Cv-4 (Vassourinha) | 1989 | 30.1 | 8-10 mos |
| PSB Cv-5 "UPL CV-5" 9(G29r-3) | 1990 | 27.91 | 6-12 mos |
| PSB Cv-7 | 1990 | 27 | 8-10 mos |
| PSB Cv-8 "VC-3" (CM 3590-1) | 1990 | 26.30 | 6-12 mos |
| PSB Cv-10 (VCv-5) | 1993 | 44.8 | 8-10 mos |
| **SWEET POTATO** | | | |
| UPL Sp-1 (Kinabakab) | 1983 | 23.4 | 110-114 |
| VSp-1 (Visca 2-1) | 1983 | 21.9 | 100-135 |
| VSp-2 (Visca 2-30) | 1983 | 19 | 100-135 |
| VSp-3 (Visca 2-3) | 1983 | 16 | 100-135 |
| BPI Sp-1 (Lo-323) | 1983 | 18.5 | 100-135 |
| UPL Sp-3 (Tinipay) | 1983 | 17.7 | 100-135 |
| BPI Sp-3 | 1985 | 14.9 | 120-140 |
| UPL Sp-5 | 1985 | 13.4 | |
| VSp-4 | 1985 | 15.4 | |
| UPL Sp-2 (G50-19) | 1986 | 13.2 | 90-120 |
| VSp-5 | 1986 | 16.2 | 90-120 |
| VSp-6 (V20-209) | 1988 | 18.73-26.01 | 110-120 |
| PSB Sp-11 (V20-429, V SP-7) | 1990 | 15.44-20.3 | 110-120 |
| PSB Sp-13 (OPS 88 or Red Wonder) | 1991 | 11.31-14.35 | 110-120 |
| PSB Sp-14 (V37-151 or Campbel) | 1992 | 13.50 | 100-120 |
| PSB Sp-16 (V30-595) | 1993 | 13.88 | 100-120 |
| PSB Sp-17 (88WS-630 or UPL Sp-6) | 1993 | 17.84 | 100-120 |
| **WATER YAM (UBE)** | | | |
| Vu-1 Basco Ubi | | | |
| Vu-2 Zambales Ubi | | | |
| Vu-3 "Leyte" (LA-100) Ubi | 1988 | 21.26 | 31 wk |
| **LESSER YAM (TUGUI)** | | | |
| VT-1 Bohol (LE-011) Tugui | 1990 | 13.79 | 35 wk |
| PSB VT-2 (Beti) | 1993 | 12.30 | 8-9 mos |
| PSB VT-3 (LE-012) | 1993 | 12.72 | 8-9 mos |
| **WHITE POTATO** | | | |
| Granola | 1983 | 24 | 90-100 |
| B71-240.2 (Dalisay) | 1986 | 24 | 100 |
| I-1035 (Montanosa) | 1986 | 24 | 100 |
| T-204 (Banahaw) | 1989 | 16.4 | 75-85 |
| BARAKA | 1992 | 19.81-20.28 | |
| **COTTON** | | | |
| Deltapine 16 | 1976 | 2.83 | 128-137 |
| UPL Ct1 | 1979 | 2.6 | 120 |
| UPL Ct2 (Batac 2) | 1982 | 2 | 111 |
| UPL Ct3 (Batac 3) | 1986 | 98 kg (seed) 0.38 lint | |
| PSB Ct4 | 1991 | 2.12 | 113 |
| **KENAF** | | | |
| UPL-K1 | 1982 | 3.09 | 203 |
| **TOBACCO** | | | |
| Giant Coker | 1976 | 1.48 | |
| Gold Harvest | 1976 | 1.41 | |
| Javi 2 | 1976 | 1.1 | |
| Si nija | 1976 | 0.93 | |
| Reax No.1 | 1976 | 1.22 | |
| Simaax | 1976 | 1.02 | |
| Resumneax | 1976 | 1.02 | |
| PFT-4 (Balikbayan) | 1983 | 2.26 | 80 |
| PFT-5 (COKER 86) | 1983 | 2.15 | 80 |

***Table 62*** *Philippine traditional rice varieties and major characteristics*

| | ADAPTABILITY Traditional Rice Variety | YIELD (mt/ha) | GROWTH DURATION (days) | DISTRIBUTION |
|---|---|---|---|---|
| | **LOWLAND** | | | |
| 1 | Dehlhinla | 1.76-2.64 | 160 | National* |
| 2 | Ketan Koetock | 1.32-2.20 | 155 | National* |
| 3 | Contenido | 2.20-2.86 | 207 | Regional: Ilocos Norte, Ilocos Sur, Abra, La Union |
| 4 | Binacroy 1 | 1.98-2.64 | 166 | Regional: Ilocos Norte, Ilocos Sur, Abra, La Union |
| 5 | Mallioc | 1.32-2.42 | 180 | Regional: Ilocos Norte, Ilocos Sur, Abra, La Union, Cotabato, Lanao,, Bukidnon |
| 6 | Seraup Besar 15 | 2.20-5.41 | 200-210 | National* |
| 7 | Rosil | 2.20 | 175 | Regional: Rizal, Cavite, Laguna,, Batangas, Tayabas |
| 8 | Apostol | 1.54-2.86 | 144 | National* |
| 9 | Binambang | 1.32- 4.40 | 195 | Regional: Rizal, Cavite, Laguna, Batangas |
| 10 | Mancasar | 1.32-2.64 | 175 | Regional: Cotabato, Lanao, Bukidnon |
| 11 | Seraup Kenchil 36 | 2.20-3.96 | 200 | Regional: Pangasinan, Tarlac, Pampanga, Nueva Ecija, Bulacan, Rizal, Cavite, Laguna, Batangas |
| 12 | Kasungsong | 2.33 | 170-180 | Regional: Ilocos Norte, Ilocos Sur, Abra, La Union, Pangasinan, Tarlac, Pampanga, Batangas and Nueva Ecija |
| 13 | Bangbang | 1.10-2.42 | 165 | Regional: Quezon, Camarines Sur, Albay, Camarines Norte, Sorsogon |
| 14 | Ramelon 2 | 2.42-3.96 | 187 | National* |
| 15 | Macan Bino | 1.76-3.08 | 170 | National* |
| 16 | Raminad 3 ** | 2.42-4.18 | 194 | National* |
| 17 | Elon-elon | 2.20-3.52 | 194 | National* |
| 18 | Kinampupoy | 1.10-2.20 | 130 | National* |
| 19 | Macan Sta. Rosa | 2.20-3.30 | 175 | National* |
| 20 | Macan Tago | 1.98-3.08 | 178 | National* |
| 21 | Wagwag | 3.17 | 205 | Regional: Pangasinan, Tarlac, Pampanga, Nueva Ecija, Bulacan |
| 22 | Milagrosa | 1.54-3.08 | 170 | National* |
| 23 | Bulastog Ortoc | 0.88-2.20 | 174 | Regional: Ilocos Norte, Ilocos Sur, Abra, La Union, Pangasinan, Tarlac, Pampanga, Nueva Ecija, Bulacan |
| 24 | Cagatusan | 0.88-2.64 | 155 | Regional: Cotabato, Lanao, Bukidnon |
| 25 | Macan 1 | 1.32-2.64 | 180 | Regional: Rizal, Cavite, Laguna, Batangas |
| 26 | Pangasinan | 1.54-1.98 | 155 | Regional: Quezon, Cam. Sur, Cam. Norte, Albay, Sorsogon |
| 27 | Raminad 4 | 1.98-4.40 | 195 | Regional: Quezon, Cam. Sur, Cam. Norte, Albay, Sorsogon, Panay or Iloilo, Capiz, Antique |
| | **UPLAND** | | | |
| 1 | Dinalaga 1 ** | 0.88-2.42 | 135 | Regional: Panay or Iloilo, Capiz, Antique |
| 2 | Inilang-ilang | 1.32-2.55 | 135 | National* |
| 3 | Pirurutong | 0.88-1.98 | 127 | National* |

*Cont'n.* ***Table 62***

| | ADAPTABILITY Traditional Rice Variety | YIELD (mt/ha) | GROWTH DURATION (days) | DISTRIBUTION |
|---|---|---|---|---|
| 4 | Portoc | 2.20 | 154 | Regional: Ilocos Norte, Ilocos Sur, Abra, La Union |
| 5 | Arabon | 0.88-2.55 | 180 | Regional: Panay or Iloilo, Capiz, Antique |
| 6 | Cutsiam | 0.88-2.20 | 110 | Regional: Panay or Iloilo, Capiz, Antique |
| 7 | Magsanaya ** | 1.32-2.64 | 140 | Regional: Panay or Iloilo, Capiz, Antique |
| 8 | Dumali | 0.88-2.20 | 100 | National* |
| 9 | Kinandang Puti ** | 1.32-2.42 | 125 | National* |
| 10 | Bilaan | 1.76-2.20 | 140 | Regional: Cotabato, Lanao |
| 11 | Goyod | 2.33 | 148 | Regional: Bukidnon, Cotabato, Lanao |
| 12 | Caroni | 0.88-2.20 | 150 | Regional: Cotabato, Lanao, Bukidnon |
| 13 | Buluhan | 0.88-2.64 | 122 | Regional: Rizal, Cavite, Laguna, Batangas |
| 14 | Tapukoy | 0.88-2.42 | 137 | Regional: Rizal, Cavite, Laguna, Batangas, Quezon, Cam. Sur, Cam. Norte, Albay, Sorsogon |
| 15 | Carreon | 1.98 | 135 | Regional: Rizal, Cavite, Laguna, Batangas |
| 16 | Lubang | 1.76-3.08 | 150 | Regional: Zambales, Bataan, Panay or Iloilo, Capiz, Antique |
| 17 | Binundoc | 1.54-1.98 | 148 | National* |
| 18 | Mangasa | 1.10-1.98 | 135 | Regional: Rizal, Cavite, Laguna, Batangas, Quezon, Cam. Sur, Cam. Norte, Albay, Sorsogon |
| | **PALAGAD** | | | |
| 1 | Malagkit Sungsong | 1.54-2.42 | 147 | National* |
| 2 | Binato | 1.85 | 140 | Regional: Ilocos Norte, Ilocos Sur Abra, La Union, Pangasinan, Tarlac, Pampanga, Bulacan |
| 3 | Taichu 65 | 1.54-5.50 | 125 | Regional: Bulacan, N. Ecija, Pampanga, Tarlac, Pangasinan |
| 4 | Sipot | 1.32-3.08 | 155 | Regional: Ilocos Norte, Ilocos Sur Abra, La Union, Rizal, Cavite, Laguna, Mindoro, Masbate, Marindugue |
| 5 | Balibod | 0.88-2.20 | 137 | Regional: Cotabato, Lanao, Bukidnon |
| 6 | Guinangang | 1.76-2.64 | 155 | National* |
| 7 | Sinadyaya | 0.88-2.20 | 130-140 | Regional: Rizal, Cavite, Laguna, Batangas |
| 8 | Pinursueging Puti | 1.32-1.41 | 115 | National* |
| 9 | Kinawayan 2 | 1.76-2.64 | 150 | National* |
| 10 | Baranay | 1.94 | 145 | Regional: Quezon, Cam. Sur, Cam. Norte, Albay, Sorsogon |
| 11 | Kaawa | 0.88-1.76 | 120 | Regional: Rizal, Batangas, Cavite, Laguna |
| | **FLOATING** | | | |
| 1 | KRA Suey | 1.32-2.20 | 165 | National |

*Sources of basic data: Abagon and Paguirigan (1953) and Philippine Seedboard Released Varieties, 1955-92 (unpublished)*

**The variety can be grown in all parts of the country.*
***These traditional rice varieties are among the National Seed Industry Council released varieties. (Raminad 3, Magsanaya & Kinandang Puti – 1955; Dinalaga – 1960)*

***Table 63*** *Crop income (P/ha) for selected crops, 1990 & 1992*

| CROP | BAS (Phil. 1992) | | BSWM (Luzon, 1990) | |
|---|---|---|---|---|
| | GROSS | NET | PRESENT | POTENTIAL |
| Irrigated Rice | 13,879 | 4,481 | 4,360 | 8,822 |
| Corn | 6,521 | 3,728 | 1,989 | 4,011 |
| Garlic | 22,190 | 168,307 | 52,813 | 111,702 |
| Onion | 118,404 | 74,810 | 31,629 | 50,859 |
| Watermelon | 55,039 | 43,730 | 54,292 | 259,614 |
| Peanut | 10,072 | 5,886 | 3,439 | 19,882 |
| Mongo | 12,063 | 9,972 | 4,060 | 19,485 |
| Chinese Cabbage | | | 119,962 | 138,168 |
| Celery | | | 66,103 | 97,322 |
| Cauliflower | | | 18,846 | 95,878 |
| Cabbage | 85,614 | 70,607 | 38,317 | 95,530 |
| Sweet peas | | | 49,243 | 83,541 |
| Okra | | | 41,569 | 76,716 |
| Carrots | | | 54,279 | 66,736 |
| Sweet pepper | | | 37,543 | 60,312 |
| Baguio beans | | | 22,247 | 57,883 |
| Mustard | | | 29,656 | 39,431 |
| Tomato | 51,086 | 39,269 | 17,659 | 38,071 |
| Green Onion | | | 6,706 | 36,004 |
| Eggplant | 47,063 | 36,246 | 22,519 | 35,418 |
| String beans | | | 10,723 | 317,477 |
| Radish | | | 8,103 | 30,224 |
| Ampalaya | | | 9,253 | 29,194 |
| Squash | | | 4,834 | 28,208 |
| Chayote | | | 17,496 | 24,692 |
| Pechay | | | 22,666 | 24,434 |
| Lettuce | | | 1,327 | 12,503 |

**Table 64** *Yield and annual growth rate of various Philippine crops 1981, 1990 & 1993*

| ITEMS | CROP YIELD (mt/ha) | | | INCREASE (DECREASE) | AAGR |
|---|---|---|---|---|---|
| | 1981 | 1990 | 1993 P | 1981/93 | 1981/93 |
| **IRRIGATED** | | | | | |
| Palay | 2.89 | 3.28 | 3.34 | 0.45 | 1.21 |
| **NON-IRRIGATED** | | | | | |
| *Food crops:* | | | | | |
| Grain | | | | | |
| Palay | 1.77 | 2.08 | 2.14 | 0.37 | 1.59 |
| White corn * | 1.01 | 1.08 | 1.25 | 0.24 | 1.79 |
| Vegetables | | | | | |
| Peanut | 0.92 | 0.78 | 0.76 | (0.16) | (1.58) |
| Mongo | 0.74 | 0.73 | 0.71 | (0.03) | (0.34) |
| Onion | 7.02 | 9.61 | 9.46 | 2.44 | 2.52 |
| Garlic | 2.67 | 2.80 | 2.86 | 0.19 | 0.57 |
| Tomato | 8.51 | 9.20 | 8.98 | 0.47 | 0.45 |
| Eggplant | 7.78 | 6.87 | 6.35 | (1.43) | (1.67) |
| Cabbage | 9.80 | 10.67 | 11.03 | 1.23 | 0.99 |
| Fruits | | | | | |
| Banana | 11.41 | 9.70 | 9.55 | (1.86) | (1.47) |
| Pineapple | 16.05 | 19.36 | 17.78 | 1.73 | 0.86 |
| Mango | 6.50 | 5.95 | 5.80 | (0.70) | (0.94) |
| Citrus | 5.15 | 5.14 | 4.89 | (0.26) | (0.43) |
| Rootcrops | | | | | |
| Cassava | 8.40 | 8.67 | 8.72 | 0.32 | 0.31 |
| Camote | 5.17 | 4.89 | 4.70 | (0.47) | (0.79) |
| Industrial crops | | | | | |
| Sugarcane | 56.73 | 79.33 | 62.48 | 5.75 | 0.81 |
| Coffee | 1.00 | 0.94 | 0.58 | (0.42) | (4.43) |
| Cacao | 0.40 | 0.54 | 0.46 | 0.06 | 1.17 |
| *Feed crop:* | | | | | |
| Yellow corn | 0.96 | 1.75 | 2.07 | 1.11 | 6.61 |
| Pasture/grasses | no data | | | | |
| *Medicinal/herbal plants:* | no data | | | | |
| *Oil crop:* | | | | | |
| Coconut | 4.35 | 3.84 | 3.68 | (0.67) | (1.38) |
| *Non-food industrial crops:* | | | | | |
| Tobacco | 1.13 | 1.29 | 1.12 | (0.01) | (0.07) |
| Abaca | 0.56 | 0.75 | 0.76 | 0.20 | 2.58 |
| Rubber | 1.51 | 2.15 | 2.07 | 0.56 | 2.66 |

*Sources of basic data:*
*BAS. 1994. Selected Statistics on Agriculture*
*BAS. Statistics on Selected Major Crops, 1981-90 (National & Regional Statistics)*
*BAS. Rice Statistics Handbook, 1980-89*
*BAS. 1987. Selected Statistics on Agriculture*
*BAECON. 1985. Statistical Handbook in Agriculture, National Data*

*p/ – 1993 Preliminary estimates, except for palay and corn.*
*AAGR – Average Annual Growth Rate*
**Includes sweet corn, pop corn, etc. classified as other varieties*


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camote, coffee, coconut, and tobacco, all of which had been given various support by the government at different occasions. Existing technological interventions are seemingly ineffective in improving per unit productivity of these.

The area planted to agricultural crops has not changed significantly over the period 1984-1993 and has remained at about 12.6 million hectares. Approximately 50 percent of the area planted is devoted to palay and corn, 40 percent to major crops, mostly coconut, and 10 percent to other crops. Palay, corn, and coconut cover about three-fourths of the hectarage. Some of the major crops which had relatively greater rates of increase in hectarage are coffee, tobacco, cacao, and cabbage. There was decline in hectarage in land area planted to abaca, onion, and garlic.

During the same period 1984-1993, the share of palay and corn in the value of agricultural crops increased from 30 percent to 40 percent while that of the major crops declined from 57 percent to 43 percent. The share of coconut in total agricultural value dwindled by half from 24 percent to 12 percent. On the average, there has been an annual decline of 0.5 percent and 0.4 percent in the hectarage and quantity, respectively, of coconut partly due to the slow replanting of old coconut plantations and the accelerated cutting of coconut trees for lumber in recent years. Among the major crops, sugarcane, banana, pineapple, abaca, cassava, camote, and citrus had greater than average annual rates of increase in value, i.e., greater than eight percent. Increasing prices have a greater effect on revenue as in the case of sugarcane, abaca, and camote which exhibited increased revenues despite declines in hectarage and quantity produced.

Despite the increased demand due to a bigger population, there were declines in the 1993 domestic output relative to 1984 levels in coconut, sugarcane, coffee, mango, abaca, peanut, mongo, garlic, and tomato. The decline in the relative share of major crops in the value of agricultural output can be partly explained by their slower rates of increase in prices relative to those of cereals like palay, corn, and other crops. Since relative prices of the latter, notably palay in 1995, dramatically increased, resources such as land, labor, and capital are expected to move towards cereals and other high-priced crops. Among the major crops, coconut and coffee had price declines while pineapple and citrus had the largest price increases over the 1984-1993 period.

A crude indicator of land productivity is measured by the ratio of quantity of output to area planted. Since agricultural hectarage in 1993 remained about the same as the 1984 level of about 12.6 million hectares while population grew annually at about 2.3 percent, then land productivity has to be raised to meet the increasing demand for food. In the 1984-1993 period, corn had the greatest land productivity increase at 4.71 percent annually; there were land productivity declines in banana, coffee, mango, tobacco, peanut, and eggplant among the major crops. The decline in land productivity for major crops, particularly sugarcane, coffee, tobacco, and cacao, was more pronounced during the 1990-1993 period.

### Domesticated Exotic Species

The reported figures below are based only on the National Meat Inspection Commission's (NMIC) reported number of animals slaughtered in slaughterhouses and dressing plants. Chicken and hog, being staples in the country, have the highest number of heads slaughtered; in 1993, 107 million heads of chicken and six million heads of hog were slaughtered. At an estimated population of 63 million, the figures for 1993 indicate an average per capita annual consumption of 1.7 heads of chicken and 0.10 head of hog. These per capita consumption estimates are clearly lower bounds since, especially in rural areas, some domesticated exotic species slaughtered for food consumption do not go through the market. With the exception of carabaos and horses, the number of animals slaughtered has been increasing. The decline in the number of carabaos and horses slaughtered may be interpreted as a positive development if their total stock has remained constant or has increased. Carabaos and horses may thus be increasingly utilized for alternative purposes. The carabao still plays a vital role in rural farming, particularly for

plowing the fields and carrying produce from farm to the market. In upland areas, horses are also used for such functions.

Based on the total inventory of domesticated exotic species and poultry from 1950 to 1993 all domesticated exotic species increased in number except for carabaos which numbered five million in 1973 but decreased by half to 2.56 million in 1993.

## 2.5 Diversity in Protected Areas

### 2.5.1 Introduction

The National Integrated Protected Areas System Act of 1992 or the NIPAS Law (Republic Act No. 7586) is a landmark legislation that recognized the importance of the integrated protected areas system as a powerful mechanism for the conservation of the country's biodiversity.

The NIPAS Law originated with the Integrated Protected Areas System Project (IPAS I), a DENR-PAWB project funded by the Japanese Government through a grant to the Philippine Government under the administration of the World Bank. DENR contracted this project to two NGO's, the University of the Philippines Science Research Foundation, Inc. and the Foundation for Sustainable Development, Inc. under the supervision of the World Wildlife Fund-Philippine Program. This project was the first serious effort to analyze the biodiversity profile of protected areas within a socio-economic context.

February 1, 1932 marked the birth of the National Parks system in the Philippines with the passage of the Act for the Establishment of National Parks. Unfortunately, its implementation was beset by a host of problems ranging from the vagueness of the law itself to the lack of knowledge in conservation principles, the dominance of commercial logging as a nationally prioritized industry from the 1950s to the 1970s, and the rampant illegal logging inside the protected areas themselves. A series of institutional reforms were initiated to mitigate these problems. However, this contributed insignificantly to the rationalization of the national parks management.

The passage of Executive Order No. 192 in 1987 marked the emergence of a new initiative in Protected Area Management with the creation of the Protected Areas and Wildlife Bureau (PAWB) which is mandated to implement the NIPAS Law, or Republic Act 7586, in June 1992.

The NIPAS law identified as initial components of the system, all areas or islands proclaimed, designated or set aside pursuant to a law, presidential decree, presidential proclamation or executive order as National Park, Game Refuge, Bird and Wildlife Sanctuary, Wilderness Area, Strict Nature Reserve, Watershed, Mangrove Reserve, Fish Sanctuary, Natural and Historical Landmarks, Protected and Managed Landscape/Seascape as well as identified virgin forests before its effectivity. There are 203 Protected Areas under the initial components of the system and 87 others which include newly protected areas under NIPAS category. Table 65 summarizes the areal coverage of these protected areas in the Philippines by region, while Tables 66 to 73 list the protected areas under different categories, including the newly proclaimed ones under the NIPAS category.

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Lory Tan

**Table 65** *Number and size (in hectare) of different categories of protected areas, by region*

| REGION | TOTAL | | INITIAL COMPONENTS | | | | | | | | OTHER PROTECTED AREAS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NATIONAL PARKS, NATIONAL MARINE PARKS NATIONAL MARINE RESERVES | | GAME REFUGES AND BIRD SANCTUARIES | | WILDERNESS AREA | | WATERSHED FOREST RESERVE | | MANGROVE SWAMP FOREST RESERVE | | TOURIST ZONES AND MARINE RESERVES | | PROTECTED AREAS DECLARED THROUGH ADMINISTRATIVE/ MEMORANDUM ORDERS | | NEWLY PROCLAIMED PROTECTED AREAS UNDER NIPAS CATEGORY | |
| | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area | No. | Area |
| PHILIPPINES | 290 | 4,067,638 | 67 | 455,514 | 8 | 924,150 | 16 | 3,297 | 85 | 1,200,129 | 27 | undetermined | 56 | undetermined | 14 | 127,749 | 21 | 1,410,261 |
| CAR | 9 | 137,553 | 4 | 18,457 | 0 | 0 | 0 | 0 | 5 | 119,096 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| REGION 1 | 16 | 25,821 | 7 | 20,995 | 0 | 0 | 0 | 0 | 9 | 4,826 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| REGION 2 | 14 | 658,266 | 1 | 819 | 2 | 10,119 | 2 | 1,095+ | 4 | 101,591 | 0 | 0 | 1 | undetermined | 0 | 0 | 4 | 544,642 |
| REGION 3 | 16 | 250,596 | 7 | 31,405 | 1 | 12 | 0 | 0 | 7 | 211,611 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 7,568 |
| REGION 4 | 88 | 1,339,636 | 12 | 183,024+ | 3 | 906,799 | 1 | 430 | 24 | 60,410 | 6 | undetermined | 32 | undetermined | 7 | 95,024+ | 4 | 93349 |
| NCR | 3 | 540 | 3 | 540 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| REGION 5 | 23 | 75,709 | 7 | 42,423 | 0 | 0 | 4 | 465+ | 5 | 32,821 | 7 | undetermined | 0 | 0 | 0 | 0 | 0 | 0 |
| REGION 6 | 14 | 180,101 | 2 | 1,997 | 0 | 0 | 0 | 0 | 7 | 125,195 | 0 | 0 | 1 | undetermined | 2 | 52+ | 2 | 52,857 |
| REGION 7 | 30 | 56,707 | 4 | 21,670 | 1 | 920 | 4 | 1,307+ | 3 | 29,865 | 5 | undetermined | 11 | undetermined | 1 | 480 | 2 | 2,467 |
| REGION 8 | 12 | 82,373 | 5 | 2,118 | 0 | 0 | 0 | 0 | 3 | 17,614 | 1 | undetermined | 1 | undetermined | 1 | 2,193 | 1 | 60,448 |
| REGION 9 | 11 | 14,390 | 3 | 3,110+ | 0 | 0 | 0 | 0 | 3 | 11,280 | 1 | undetermined | 5 | undetermined | 0 | 0 | 0 | 0 |
| REGION 10 | 10 | 144,743 | 2 | 53,319 | 0 | 0 | 0 | 0 | 4 | 114,970 | 2 | undetermined | 2 | undetermined | 0 | 0 | 1 | 29,716 |
| REGION 11 | 14 | 270,396 | 2 | 73,494 | 0 | 0 | 1 | undetermined | 5 | 103,589 | 1 | undetermined | 3 | undetermined | 0 | 0 | 2 | 93,313 |
| REGION 12 | 9 | 322,612 | 1 | 48 | 1 | 6,300 | 0 | 0 | 2 | 54,714 | 0 | 0 | 0 | 0 | 3 | 30000+ | 2 | 231,550 |
| REGION13 | 12 | 325,839 | 0 | 0 | 0 | 0 | 4 | undetermined | 3 | 32,089 | 3 | undetermined | 0 | 0 | 0 | 0 | 2 | 293,750 |
| ARMM | 9 | 182,355 | 7 | 1895+ | 0 | 0 | 0 | 0 | 1 | 180,460 | 1 | undetermined | 0 | 0 | 0 | 0 | 0 | 0 |

Source: PAWB 1997 August

*Table 66* *National parks/national marine parks/national marine reserves in the Philippines*

| BIOGEO-GRAPHIIC ZONE | NAME | REGION | LOCATION | ESTABLISHMENT | | AREA | SPECIAL FEATURES | EXAMPLES OF FLORA AND FAUNA |
|---|---|---|---|---|---|---|---|---|
| | | | | Legislation | Date | (ha) | | |
| B | Cassamata hill | CAR | Bangued, Abra | Proc. 1305 | 8/26/74 | 57 | Panoramic view of Bangued and its surrounding area | Mahogany (Swietenia sp.), teak (Tectona grandis) Hawks, owls, finches & mayas. |
| | Mt. Data | CAR | Along the Baguio-Bontoc National Road, Benguet, Ifugao and Mt. Province | Proc. 65<br>Proc. 634 | 6/3/36<br>10/8/40 | (2398)<br>5,512 | Pine forests; natural scenery; deep ravines; temperate climate | Pine forest : Pinus insularis as dominant species, Swifts, swallows, sterling, mynah and dear |
| | Mt. Pulog | CAR | Baguias & Kabayan Benguet, Kiangan, Ifugao and Kayapa Nueva Vizcaya | Proc.75 | 2/20/87 | 11,550 | Pine forests; habitat of unique species of cloud rats; mountain lake; dwarf bamboos; deep ravines; temperate climate | Dwarf bamboos (Arunolinaria *nitakayamensis), Pinus* insularis, Cloud rats (Crateromys schadenbergii) |
| | Balbalasang-Balbalan | CAR | Balbalan, Kalinga Apayao | R.A. 6463<br>Proc. 1357 | 6/17/72<br>12/9/74 | 1,338 | Pine forests; sparkling streams and temperate climate | Predominantly pine trees |
| | Paoay Lake | 1 | Paoay, Ilocos Norte | R.A. 5631<br>P.D. 1554 | 6/21/69<br>6/11/78 | (1744)<br>340 | Freshwater lake | Zebra dove, painted quail |
| | Tirad Pass[1] | 1 | Cervantes, Ilocos Sur | Proc. 294<br>Proc. 433 | 7/20/38<br>7/23/68 | 6,320 | Historical outdoor recreation area under the National Shrine Commission | Pine and mossy forest, bats, wild cats, monitor lizard, squirrel |
| | Besang Pass | 1 | Cervantes, Ilocos Sur | Proc. 55 | 8/10/54 | 304 | Formerly part of Tirad pass; historical and superb natural scenery; mountainous terrain, cool climate with landmark of World War II | Pine and mossy forests Hawks, doves, ducks, finches and wild boar |
| C | Fuyot Springs | 2 | Ilagan, Isabela | Proc.327 | 10/8/38 | 819 | Springs; caves; rock formations | Lowland dipterocarp forest, Wild pig, deer, monkey, birds belonging to the families of Ralidae and Columbidae |
| D | Northern Luzon Heroes Hill | 1 | Sta. Maria & Narvacan, Ilocos Sur | Proc. 132 | 7/9/63 | 1,316 | Historical; Panoramic | Molave (Vitex sp.) forest, the rest are grasslands under cultivation |
| | Agoo-Damortis | 1 | Agoo & Rosario, La Union | R.A. 4570 | 6/19/65 | 10,947 | Extensive shoreline with sandy beaches ideal for swimming; colorful fishes; recreational resort | Basically disturbed ecosystem, no significant record on diversity |
| | Manleluag Spring | 1 | Mangatarem, Pangasinan | Proc. 612 | 9/3/40 | 92 | Medicinal hotsprings and health resort | Natural growth dipterocarp forest with portion covered with grasslands; wild pigs, wild chicken, hornbills, coleto |
| | Hundred Islands[1] | 1 | Alaminos, Pangasinan | Proc. 1816 | 1/30/79 | 1,676 | Island groups, resort, Karst residue, administered by PTA | Limestone Forest, birds |

*Cont'n.* **Table 66**

| BIOGEO-GRAPHIC ZONE | NAME | REGION | LOCATION | ESTABLISHMENT | | AREA | SPECIAL FEATURES | EXAMPLES OF FLORA AND FAUNA |
|---|---|---|---|---|---|---|---|---|
| | | | | Legislation | Date | (ha) | | |
| D | Callao Cave[1] | 2 | Penablanca, Cagayan | Proc. 827<br>(Proc. 416) | 7/16/35<br>6/29/94 | (192)<br>(4136) | Multi-chambered caves; deep canyons; rock formations; beautiful stream; recreational resort | Rubiaceae, putaceae, molave *(Vitex sp.)* and narra *(Pterocarpus)* 51 birds and 29 mammals |
| | Mintalungao | 3 | Gapan & Gen. Tinio, Nueva Ecija | R.A. 5100 | 6/11/67 | 2,018 | Cathedral like caves; exquisite rock formation; Natural swimming pool | Dipterocarps, molave, rattan; deer, monkey, reptiles, birds |
| | Capas Death March Monument | 3 | Capas, Tarlac | R.A. 826 | 8/14/52 | 2 | Erected in honor of the World War II death march participants | Disturbed, very limited information on fauna |
| | Mt. Arayat | 3 | Arayat & Magalang, Pampanga | Proc.594<br>Proc.203 | 6/27/33<br>9/16/37 | (3714.03)<br>3,715 | Remnant of natural forest; natural waterhole; scenic spots; recreational resort. | Teak , narra, fire tree, ipil-ipil, rattan; deer, wild boar, snakes; wild ducks; pigeons |
| | Aurora Memorial | 4 | Bongabon, Nueva Ecija and Baler, Quezon | Proc. 220<br>Proc. 744 | 11/11/37<br>8/11/41 | (2356)<br>5,676 | Dipterocarp forest; streams and rivers; springs for swimming | Covered with dipterocarp forest, deer, monitor lizard, lemur, shrew, birds |
| | Biak-na-bato | 3 | San Miguel, and Dona Remedios Trinidad, Bulacan | Proc. 223<br>Proc. 2204<br>Proc. 84<br>Proc. 401 | 11/16/37<br>6/9/82<br>3/9/87<br>4/11/89 | (2117)<br>(330.62)<br>(2117.09)<br>659 | (Historical where Pact of Biak-na Bato was signed), limestone formation; caves; remnants of dipterocarp forest | Alibanghang *(Bauhinia sp.)*, Dao *(Dracontomelon dao)*, Tibig *(Ficus nota) and Lanog (Planchonia spectabilis); Phil. deer (Cervus sp.)*, Bats *(Tadarida spp.)*, Philippine monkey *(Macaca fascicularis)* and Philippine mallard (Anas luzonica) |
| | Quezon Memorial/ Ninoy Aquino Parks and Wildlife Nature Center | NCR | Diliman, Quezon City<br>Diliman, Quezon City | Proc. 42<br>Proc. 1402<br>MNR Adm. Or No. 4 | 7/5/54<br>3/20/75<br>series of 1986 | (197.8)<br>59 | Man-made lagoon; mini-zoo; play-grounds; picnic areas; recreational area | man-made forest<br>Enclosed in the Mini-zoo are eagles, crocodiles, lions, tigers, snakes, etc. |
| | Luneta[1] | NCR | Ermita, Manila | Proc. 234 | 12/19/55 | 16 | Urban Park, play grounds, picnic areas, Manila Sunset, administered by the National Parks Development Committee adjacent to Manila Bay, planetarium | Man-made forest; orchidarium |
| | Manila Bay Beach Resort[1] | NCR | Manila and Pasay Cities, Parañaque | Proc. 41<br>P.D. 1085 | 7/5/54<br>2/4/77 | 465 | Transferred under the administration to the Public Estates Authority | Manila Bay |
| | Taal Volcano Island[3] | 4 | Batangas | Proc. 235 | 7/22/67 | (4537) | Famous & picturesque active volcano within a lake; a unique natural phenomenon | Grassland and patches of forest; sparrow, woodpecker, etc. |
| | Mts. Palaypalay- Mataas na Gulod | 4 | Ternate and Maragondon, Cavite | Proc. 1594 | 10/26/76 | 4,000 | Dipterocarp forest | Dipterocarps, kamagong, etc; deer, snakes, wild chicken, wild boar, birds |
| | Mt. Makiling[1] | 4 | Los Baños and Calamba, Laguna<br>Sto. Tomas, Batangas | Proc.552<br>Proc.692 | 2/23/33<br>8/2/60 | 3,329 | Dipterocarp Forest, Natural Laboratory of UPLB, outdoor recreation, mudspring, etc. | Dipterocarps, snakes, birds, monkeys, rattan, vines, etc. |
| | Pagsanjan Gorge[1] | 4 | Cavinti, Lumban, Laguna | Proc. 392<br>Proc. 1551 | 3/28/39<br>5/31/76 | 153 | Outdoor recreation area | Waterfalls |

Cont'n. **Table 66**

| BIOGEO-GRAPHIC ZONE | NAME | REGION | LOCATION | ESTABLISHMENT | | AREA | SPECIAL FEATURES | EXAMPLES OF FLORA AND FAUNA |
|---|---|---|---|---|---|---|---|---|
| | | | | Legislation | Date | (ha) | | |
| D | Mt. Banahaw-San Cristobal[4] | 4 | Majayjay, Laguna, Lucban Tayabas, Quezon | Proc. 716<br>Proc. 715<br>E.O 224 | 5/21/41<br>8/9/66<br>7/16/87 | (11133.3)<br>(11133.3)<br>undetermined | Twin-mountain; natural scenery; waterfalls; dipterocarp forest; mystical caves; springs; rock formations; and invigorating climate | Red Lauan, tanguile, mayapis, rattan and vines; Giant rats, bats, wildcats, reptiles and ground lizards. |
| | Quezon | 4 | Atimonan, Padre Burgos, and Pagbilao, Quezon | Proc. 740<br>Proc. 594 | 10/25/34<br>8/5/40 | (535.08)<br>983 | Virgin dipterocarp forests; winding road; deep ravines; rock formations; superb scenery | Dipterocarps; Diospyros sp.; hornbills Phil. deer, forest kingfisher, spotted wood kingfisher and Luzon little crow, Philippine rind rat |
| | National Park, Wildlife Sanctuary and Game Preserve 5 | 4 | Provinces of Laguna, Quezon, Rizal and Bulacan | Proc. 1636<br>Exec. Or. 192<br>Proc. 196<br>Proc. 225 | 4/18/77<br>6/10/87<br>12/10/87<br>3/1/88 | (46310)<br><br>(34681)<br>34,681 | Dipterocarp forest; invigorating climate | Dipterocarps; deer, reptiles, many species of common birds |
| | Hinulugang Taktak | 4 | Antipolo, Rizal | R.A. 6964 | 9/18/90 | 1 | Picnic area | |
| | Bicol | 5 | Basud and Daet, Camarines Norte & Sipocot & Lupi, Camarines Sur | Proc. 657<br>Proc. 655 | 2/13/34<br>12/23/40 | (4225)<br>5,201 | Dipterocarp forest; natural swimming pool; scenic spots; recreational area | Hanging parakeet, cookatoo, cloud rat, palm and malay civet; dipterocarps |
| | Libmanan | 5 | Libmanan, Camarines Sur | Proc. 654 | 2/6/34 | 19 | Series of crystal caverns and cataracts with stalagmites and stalactites | Coconut and other agricultural crops; monitor lizards, coucal, swifts, bats, civet cat |
| | Caramoan | 5 | Caramoan, Camarines Sur | Proc. 291 | 7/20/38 | 347 | Caves; panoramic hills; superb shoreline; recreational areas | Parrots, parakeets, gallinules, pigeons and owls |
| | Mt. Isarog | 5 | Naga, Calabanga, Tinambac, Goa, Tiagaon and Pili, Camarines Sur | Proc. 293 | 7/20/38 | 10,112 | Home of Negritos; gorges; wonderful canyons; deep ravines; waterfalls approximately 40 meters, with natural swimming area; dipterocarp forest; endemic wildlife; invigorating climate; superb scenery | Flying fox *(Harpiocephala harpyia)* bats *(Murina cyclotis)*, Philippine cobra monkeys and parrots |
| | Mayon Volcano | 5 | Camalig, Guinobatan, Libon, Ligao, Malilipot & Tabaco, Albay | Proc. 292 | 7/20/38 | 5,459 | Famous active volcano with almost perfect cone; hot springs; rock formations; superb natural scenery | Dwarf trees, grasses and few dipterocarp trees; many birds, Wild pig, wild cat and monitor lizard |
| | Bulusan Volcano | 5 | Casiguran, Barcelona, Irosin & Juban, Sorsogon | Proc. 811 | 6/7/35 | 3,673 | Famous crater; mineral hot springs; peculiar rock formations | Kingfisher, woodpecker, hawks, zebra and green imperial pigeons |
| | Tiwi[5] | 5 | Tiwi, Albay | Proc.47<br>Proc.739 | 7/10/54<br>8/14/70 | 17,611 | Geothermal Reservation under NPC | Limited information on flora and fauna |
| E | Olongapo Naval Base Perimeter | 3 | Olongapo City, Zambales | Proc.478 | 10/22/68 | 9 | Open space with stream within the heart of Olongapo City | Disturbed; highly insignificant as a reserve |

*Cont'n.* **Table 66**

| BIOGEO-GRAPHIC ZONE | NAME | REGION | LOCATION | ESTABLISHMENT | | AREA | SPECIAL FEATURES | EXAMPLES OF FLORA AND FAUNA |
|---|---|---|---|---|---|---|---|---|
| | | | | Legislation | Date | (ha) | | |
| E | Roosevelt | 3 | Hermosa & Dinalupihan Bataan | Proc. 567<br>Proc. 508 | 3/30/33<br>12/17/65 | (1485)<br>1,335 | Dipterocarp forest; natural spring; recreational resort | Dipterocarps, mahogany, narra; heron, quails, orioles |
| | Bataan | 3 | Hermosa, Orani, Samal, Abucay Pilar, Balanga, Bagac and Morong, Bataan | Proc. 24<br>Proc. 25<br>Proc. 1956<br>Proc. 192 | 12/1/45<br>4/18/66<br>3/25/80<br>11/27/87 | (31000)<br>(29853)<br>(23853)<br>23,668 | Historical; tropical moist forest; waterfalls; with sandy beaches along coastal zone | Leucaena l., Psidium guajava, Gliricidia sepium and bamboos; hornbill, quail, woodpecker and sparrow, squirrel, deer, bats |
| F | Naujan Lake | 4 | Naujan Pola and Victoria, Oriental Mindoro | Proc. 292<br>Proc. 335 | 4/27/56<br>1/25/68 | (21655)<br>21,655 | Freshwater lake; dipterocarp forest | Coconut, rambutan, coffee; least bittern, cattle egret, swamphen |
| | Mts. Iglit-Baco | 4 | Sablayan, Occidental Mindoro & Bongabon, Oriental Mindoro | R.A. 6148 | 11/9/70 | 75,445 | Habitat of tamaraw (Bubalus *mindorensis); natural grasslands;* dipterocarp forest | Families of the trees are: Leguminosae, Eurphorbiaceae, Dipterocarpaceae and Anacardiaceae pigeons, hornbills, swifts, swiftlets, kingfisher |
| G | Bulabog-Putian | 6 | Dingle & San Enrique, Iloilo | Proc. 760 | 6/14/61 | 854 | Presence of "tisok," a natural hole where rain water percolates; caverns; springs | Dao, molave, antipolo,narra, teak; bats, swifts |
| | Mt. Canlaon* | 6 | Bago, La Carlota, La Castellana Murcia, Canlaon, San Carlos, Negros Occidental and Vallehermosa, Negros Oriental | (Proc. 721) | 8/8/34 | (24557.6) | Picturesque cone of the active volcano; waterfalls; hotsprings; gorges; rock formations; virgin forest; mossy forest; lagoon, endemic wildlife | Sanggumai *(Dendrobium anosmym),* pitcher plant *(Nepenthes spp.)* and staghorn fern *(Platycerium stoufi)* Spotted deer, wild pigs, Philippine monkey reptiles and lizards |
| H | Sohoton Natural Bridge | 8 | Basey, Samar | Proc. 831 | 7/19/35 | 840 | Natural stone bridge; other rock formations; winding Sohoton river; cathedral-like cave; dipterocarp forest; teeming with wildlife | Dipterocarps are the dominant species combined with the families Anacardiaceae, Moraceae, Sapindaceae; deer, hornbill, giant scops owl, Philippine eagle |
| | Kuapnit-Balinsasayao | 8 | Baybay & Abuyog, Leyte | Proc. 142 | 4/16/37 | 364 | Home of bats and swifts; caves with guano deposits | Palm civet, wild pig, Philippine macaque, reptiles like monitor lizard *(Varanus salvator)* and land turtle *(Cyclemys ambionensis)* |
| | MacArthur Landing (Imelda Park) | 8 | Palo, Leyte | LOI 572 | 7/12/77 | 7 | Historical; extensive shoreline; recreational | Calachuchi, American roses, green yellow Japanese bushes and Macarthur palms. |
| | Mahagnao[1] | 8 | Burauen & La Paz, Leyte | Proc. 184 | 8/27/57 | 635 | Rock formations; beautiful lakes; panoramic view; dipterocarp forest | Dipterocarps e.g. Shorea negrosensis *S. contorta, mahogany* |
| | Tongonan Hot Spring[1] | 8 | Ormoc City, Leyte | Proc. 161<br>Proc. 1112 | 6/14/57<br>2/21/73 | 272 | Geothermal Reservation under NPC | |

Cont'n. **Table 66**

| BIOGEO-GRAPHIC ZONE | NAME | REGION | LOCATION | ESTABLISHMENT | | AREA | SPECIAL FEATURES | EXAMPLES OF FLORA AND FAUNA |
|---|---|---|---|---|---|---|---|---|
| | | | | Legislation | Date | (ha) | | |
| H | Rajah Sikatuna | 7 | Carmen, Sierra, Bullones, Valencia, Garcia, Hernandez, Dimiao, Bilar, Batuan, Bohol | Proc. 129 | 7/10/87 | 9,023 | Last remaining forested portion of Bohol Island, Home of Flying Lemur Philippine Tarsier, Mossy forest | Flying lemur, Philippine tarsier Dipterocarp sp., mossy forest, Philippine cockatoo, Philippine trogon, wild pig, Malay civet, Philippine palm civet, monitor lizard, green imperial pigeon, black-backed coleto, Philippine grass owl, screech owl |
| I | Taklong Island | 6 | Guimaras, Iloilo | Proc. 525 | 2/8/90 | 1,143 | White sandy beaches interesting coves and coral reefs, two major islands surrounded with 46 islets | Rabbit fish (941 species), sea grass, invertebrates |
| J | Sudlon | 7 | Cebu, Cebu | Proc. 56 | 4/11/36 | 696 | Caverns; waterhole; wonderful scenery; temperate climate; historical | Molave trees, pine , Dipterocarp species, Sun bird (Nectarina *jugularis), swiflet (Collocalia esculenta), Bulbul (Pycnonotus goiavier) and wagtail (Motacilla cinerea robusta)* |
| | Central Cebu | 7 | Balamban, Toledo, City Cebu | Proc. 202<br>Proc. 835-A | 9/15/37<br>3/27/71 | (15393.58)<br>11,894 | Where President Magsaysay met his fiery death | *Cinammomun cebuensis; Coleto,* sunbird, black shama, starling, white eye, pied chat, kingfisher |
| | Guadalupe Mabugnao-Mainit Hot Springs | 7 | Carcar, Cebu | R.A. 6429<br>MNR Adm. Or. No. 32 | 6/17/72<br>5/30/86 | Undetermined<br>58 | Cold and hotsprings; recreational resort; caves interconnected and characterized by stalagmites and stalactites | Mahogany, katoan bangkal and ornamental trees; zebra dove fruit dove, painted quail, gecko olive backed sunbird, swallow, glossy swiftlet. |
| K | St. Paul Subterranean River | 4 | Puerto Princesa, Palawan | Proc. 835 | 3/26/71 | 3,901 | Underground river | *Dracontomelon dao, Diospyrus spp.* and Pometia primata, Philippine monkey, mound builders (tabon birds), pacific reef egrets, Philippine cockatoo, talking mynah |
| | Tubbataha Reef | 4 | Central Sulu Sea, Palawan | Proc. 306 | 8/11/88 | 33,200 | High diversity of reef fish and fauna, diverse coral (46 coral genera, 379 fish species, 40 fish families), coral cover (70 % - 80 %), Two atolls | Brown boobies, Red footed boobies, Tern, Common noddy, Sooty tern, Crested tern, Euphorbia sp., macro algae and seagrasses, Tridacnid clams, helmet shells, black tip shark, white tip shark, manta rays, eagle rays, marine turtle |
| L | Mt. Dajo' | ARMM | Patikul and Talipau, Sulu | Proc. 261 | 2/28/38 | 215 | Historical; only mountain in Jolo, Sulu | No data on flora and fauna |
| M | Rizal (Dapitan) | 9 | Dapitan, Zamboanga | Proc. 616 | 9/3/40 | 10 | Where Dr. Jose Rizal was exiled; scenic seascape | Baluno (Mangifera caesia), Ipil Philippine bulbul, coleto, morning dove, phyton |

*Cont'n.* **Table 66**

| BIOGEO-GRAPHIC ZONE | NAME | REGION | LOCATION | ESTABLISHMENT | | AREA | SPECIAL FEATURES | EXAMPLES OF FLORA AND FAUNA |
|---|---|---|---|---|---|---|---|---|
| | | | | Legislation | Date | (ha) | | |
| M | Basilan | 9 | Lamitan, Basilan | Proc. 457<br>Proc. 1531 | 9/25/39<br>2/2/76 | (6451)<br>3,100 | Waterfalls; natural swimming pool; virgin dipterocarp forest moist forest; abundant wildlife invigorating climate | Dipterocarps, Podocarpus, Pandanus; wild boar, phyton green parrots, hanging parakeets woodpeckers, owls, orioles Philippine eagle, tarsier, giant scops owls, rufous hornbill, Phil. deer |
| N | Sta. Cruz Islands[7] | 9 | Zamboanga City | Proc.654<br>Proc. 1801 | 2/4/75<br>11/10/78 | Undetermined | Also covered by Proclamation 1801 declaring the area as Tourist Zone and Marine Reserve under PTA Beach areas, etc. | Beach Forest limited information on fauna |
| | Initao | 10 | Initao, Misamis Oriental | R.A. 3568 | 6/21/63 | 57 | Virgin dipterocarp forests; scenic spot; sandy beach; caves & recreational areas. | Kamagong (Diospyros philippinensis) tangisan bayawak (Ficus variegata), margapali (Dehassia triandra) talisay gubat (Terminalia foetidissima) bats, tarsier, lizards |
| | Mt. Kitanglad[8] | 10 | Manolo Fortich, Sumilao, Impasugong Malaybalay, Lantapan Talakag, Baungon & Libona, Bukidnon | Proc. 677 | 12/14/90 | (29,716) | Habitat of Philippine Eagle; virgin dipterocarp and mossy forest; composed of range of mountains with features such as; waterfalls, small mountain lake, caves and rock formation | Dipterocarps, Podocarpus philip-*pinensis, Kleinhovia hospita;* Philippine eagle, serpent eagle, Brahminy kite, hornbill, finches, mynah |
| | Mt. Malindang NP & Watershed[9] | 10, 9 | Oroquieta, Ozamis City, Calamba Bonifacio and Jimenez in Misamis Occidental and Zamboanga | R.A. 6266 | 6/19/71 | 53,262 | contains several peaks with high elevations and intact forest cover that are ideal for mountaineering and nature observation, has a climate that is good for summer relaxation, crater lake in Lake Duminagat, Liboron Valley, several big rivers and beautiful sceneries, Dipterocarp forest, pine rainforest, mossy forest | Almaciga, Catmon, Bakon Binunga, Gubas, etc. Hagonoy, Lingatong, Pugahan, Anibong, Liveworth, Kaningag, Kapok, Mayana, ferns Philippine tarsier, Philippine flying lemur, Malindang deer, Philippine flying squirrel, Philippine deer, Philippine macaque, wild boar Palm civet, Tinggalong, giant flying fox, etc. |
| | Mainit Hotsprings | 11 | Compostela, Davao | Proc. 446 | 12/12/57 | 1,381 | Medicinal hotsprings; dipterocarp forest; rock formation and cold springs | Dipterocarps; no record on fauna |
| | Mt. Apo[2] | 11 | Kidapawan, North Cotabato & Guianga & Sta. Cruz, Davao | Proc. 59<br>Proc. 35 | 5/9/36<br>5/8/66 | (76,900)<br>(72,813.59)<br>72,113 | Volcanic mountain; rock formations waters falls; mountain lakes; medicinal hotsprings; home of the Phil. Eagle; dipterocarp forest; the highest peak in the Phil. | Flying lemur, Philippine monkey, wild pig, Philippine deer, Phiippine eagle; Dipterocarps (84 recorded spp. of birds) |
| | Sacred Mountain[1] | ARMM | Marawi City, Lanao del Sur | R.A. 4190 | 5/5/65 | 94 | Panoramic mountain; forest rich with interesting wildlife | Pigeons, hawks, snakes, lizards |
| | Rungkunan[10] | ARMM | Ramain, Lanao del Sur | R.A. 4190 | 5/5/65 | Undetermined | Beautiful sparkling stream, virgin forest; invigorating climate. | Pigeons, hornbills, hawks, crow, kingfishers, orioles, parrots, wild boar, snakes, lizards, deer |
| | Lake Dapao[1] | ARMM | Pualas, Lanao del Sur | R.A. 4190 | 5/5/65 | 1,500 | Scenic Lake; recreational | Giant scops owls, woodpeckers, pigeons, hornbill, parrots |

Cont'n. **Table 66**

| BIOGEO-GRAPHIC ZONE | NAME | REGION | LOCATION | ESTABLISHMENT | | AREA | SPECIAL FEATURES | EXAMPLES OF FLORA AND FAUNA |
|---|---|---|---|---|---|---|---|---|
| | | | | Legislation | Date | (ha) | | |
| N | Lake Butig | ARMM | Butig, Lanao del Sur | R.A. 4190 | 5/5/65 | 68 | recreational area; swimming resort; invigorating climate. | Dipterocarps; hornbill, parrots, woodpeckers, Philippine monkey, wild ducks |
| | Salikata[1] | ARMM | Lumba Bayambao, Lanao del Sur | R.A. 4190 | 5/5/65 | Undetermined | Basin of Gata river; peculiar rock formations; scenic landscape | Dipterocarps, various orchids; wild chickens, hornbill, deer, wild boar, snakes |
| | Pantuwatava[2] | ARMM | Saguiran, Lanao del Sur | R.A. 4190 | 5/5/65 | 20 | Recreational resort | Herons, wild ducks, kingfishers |
| | Mado Hotspring[3] | 12 | Awang, Cotabato | R.A. 456 | 9/25/39 | 48 | Medicinal hotspring; natural swimming pool; and health resort. | Southern side is cogon and eastern parts planted with coconut and other agricultural crops. owls, parrots, wild ducks, Philippine deer |

Source: PAWB, 1997 August

[1] *Under the jurisdiction of other government agencies*
[2] *Ammended as Protected Area Landscape Sea scape by virtue of Proclamation 416 dated 29 June 1994*
*Ammended as Protected Area Landscape by virtue of Proclamation 906 dated*
[3] *Part of the initially defined site has been placed under the jurisdiction of NPC by virtue of E.O. 224 dated 16 July 1987.*
[4] *Part has been proclaimed as Protected Landscape*
[5] *Newly Proclaimed as Natural Park*
[6] *Under the jurisdiction of other government agencies, also proclaimed as a tourist zone and marine reserve under Proclamation 1801 dated 1978.*
[7] *Proclaimed both as National Park and Watershed Reservation*
[8] *Part of the site (701 has.) has been placed under the jurisdiction of PNOC by virtue of Proclamation 853 dated 30 January 1992. Also proclaimed as Natural Park*
[9] *Under the jurisdiction of other government agencies, area undetermined.*

**Table 67** *Game refuges and bird sanctuaries in the Philippines*

| BIOGEO-GRAPHIC ZONE | NAME | REGION | LOCATION | AREA (ha) | PROCLAMATION NO. | DATE ESTABLISHED |
|---|---|---|---|---|---|---|
| D | 1 Magapit | 2 | Callao & Gattaran, Cagayan | 4,554 | Adm. Order No.10<br>Proc. No. 839<br>Proc. No.1541 | 8/15/47<br>12/28/55<br>4/20/76 |
| | 2 Salinas Deer Refuge | 2 | Salinas, Bambang, N. Vizcaya | 5,565 | Proc. No.53<br>Proc. 240 | 11/29/26<br>12/28/55 |
| E | 3 Lake Malimanga | 3 | Candelaria, Zambales | 12 | Proc. No. 1949 | 3/14/80 |
| F | 4 Calavite & F. B. Harrison | 4 | Sablayan and Mamburao Occidental Mindoro | 140,000 | Executive Order No. 9 | 1/28/20 |
| I | 5 Olango island[1] | 7 | Sta. Rosa and Panganan, Lapu-Lapu, Cebu | 920 | Proc. No. 903 | 5/14/92 |
| J | 6 Calauit | 4 | Busuanga Island, Palawan | 3,400 | Proc. No. 1578 | 8/31/76 |
| K | 7 Palawan [2] | 4 | Palawan | 763,399 | Proc. No. 219<br>Proc. No. 530-B<br>Proc. No. 1232<br>Proc. No. 1440 | 7/2/67<br>3/8/68<br>2/6/74<br>6/19/75 |
| N | 8 Lake Buluan | 12 | Koronadal, Buluan, Kidapawan, North Cotabato | 6,300 | Proc. No. 56 | 12/1/26<br>12/1/26 |

[1] *Also proclaimed as Tourist zone and Marine Reserve by virtue of Proclamation No. 1801 dated 1978. RAMSAR site*
[2] *Also proclaimed as Mangrove Swamp Forest Reserve, covers other protected areas*

Source: PAWB, 1997 August

**Table 68** *Wilderness areas/mangrove swamp forest reserves in the Philippines*

| | NAME | LOCATION | REGION | PROCLAMATION NO. | PROCLAMATION DATE | AREA |
|---|---|---|---|---|---|---|
| 1 | Isabela (Monte-Alto Timber Resource Corporation-parcel 1 and 2) | Echague and San Mariano, Isabela | 2 | 120 | June 19,1987 | 1095 |
| 2 | Palanan Wilderness Area | Isabela | 2 | LOI 917 and 917a | August 22,1979 and September 7,1979 | undetermined |
| 3 | Island of Alibijahan | Ragay Gulf, Bondoc Peninsula in Quezon | 4 | 2151 | December 29,1981 | 430 |
| 4 | Islands of Basot, Quinalaang and Malabungot | Camarines Sur | 5 | 2151 | December 29,1981 | 306 |
| 5 | Islands of Guinauayan, Naro, Chico and Pobre | Asid Gulf in Masbate | 5 | 2151 | December 29,1981 | 141 |
| 6 | Islands of Majaba and Napayauan | Sibuyan Sea, Masbate | 5 | 2151 | December 29,1981 | 18 |
| 7 | Island of Dampalit | Samar Sea in Masbate | 5 | 2151 | December 29,1981 | undetermined |
| 8 | Island of Bantayan | Visayan Sea in Cebu | 7 | 2151 | December 29,1981 | undetermined |
| 9 | Islands of Catiil, Colangaman, Lomislis, Tangangdio, Tintiman and the Islet of Pamasuan | Caniagao Channel in Bohol | 7 | 2151 | December 29,1981 | 210 |
| 10 | Islands of Budlanan | Cebu Strait in Bohol | 7 | 2151 | December 29,1981 | 19 |
| | Bugatusan | | | | | 6 |
| | Panga | | | | | 19 |
| | Cabgan, Canconstino, Tabaon, Maagpit, and Islets | | | | | undetermined |
| | Cancostino, Tabaon, Maagpit and Islets of Basilan | | | | | undetermined |
| | of Bugatusan, Hayaan, Inanoran, and Poom Point | | | | | undetermined |
| | East of Basilan Islet | | | | | undetermined |
| 11 | Islands of Banaon | Camotes Sea, Bohol | 7 | 2151 | December 29,1981 | 599 |
| | Basaan | | | | | 148 |
| | Saac | | | | | 45 |
| | Tambu | | | | | 194 |
| | Bambanon | | | | | 67 |
| 12 | Island of Pandasan | Davao Gulf, Davao del Sur | 11 | 2151 | December 29,1981 | undetermined |
| 13 | Islands of Lamagon, Cepaya and Corbeto | Panag Bay, Surigao del Norte | 13 | 2151 | December 29,1981 | undetermined |
| 14 | Islands of Rasa | Hinatuan Passage, Surigao del Norte | 13 | 2151 | December 29,1981 | undetermined |
| 15 | Islands of Siargao, Poneas, Dahican, Tona, Laonan Abanay and Bancuyo | Dinagat Sound, Surigao del Norte | 13 | 2151 | December 29,1981 | undetermined |
| 16 | Islands of Awasan, Cabilan, Capaquian, Sughuhan and Tagboaba | Awasan Bay, Surigao del Norte | 13 | 2151 | December 29,1981 | undetermined |
| | TOTAL | | | | | 3297+ |

Source: PAWB, 1997 August

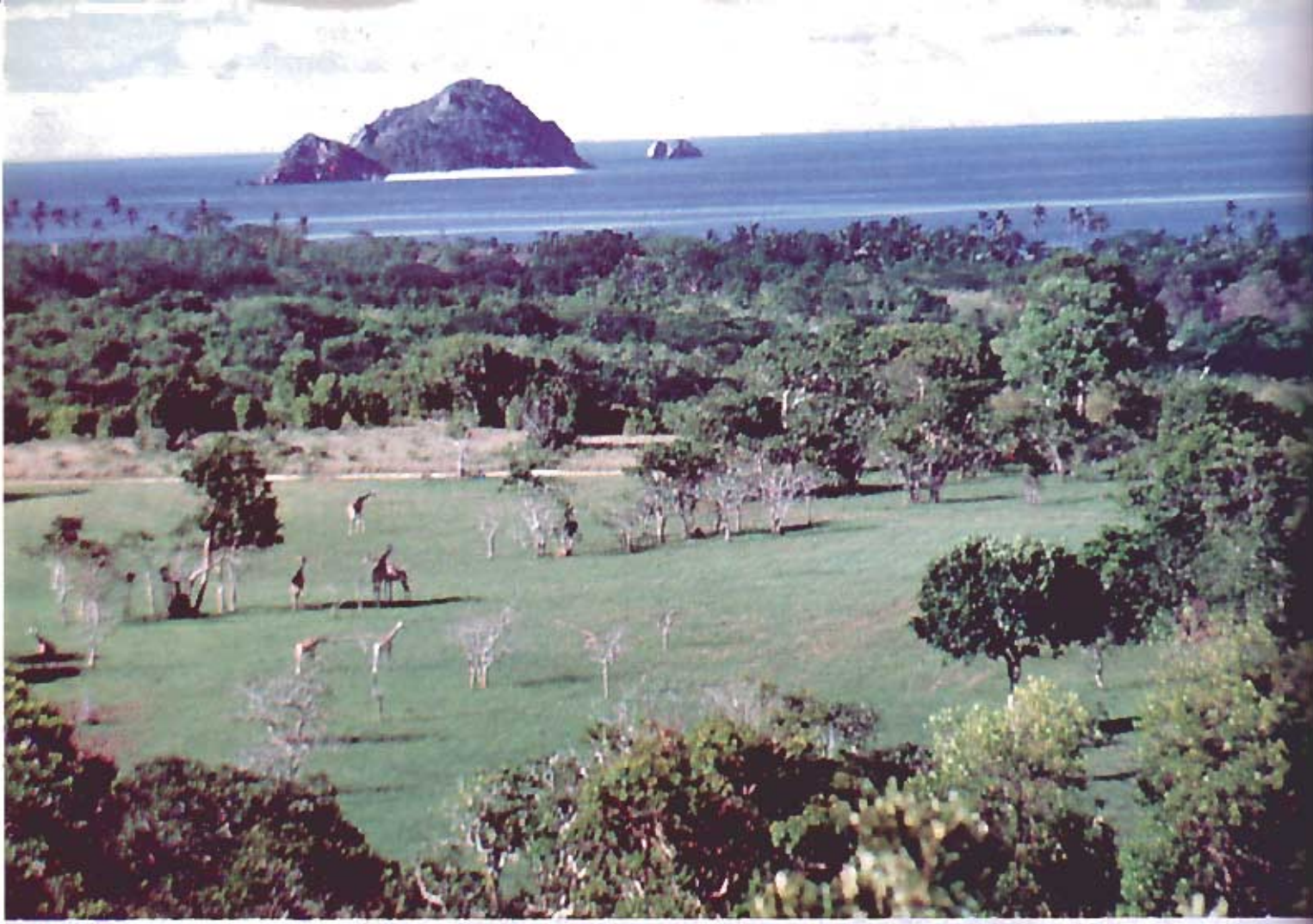


*Table 69 Watershed reservations (initial components of NIPAS) in the Philippines*

| BIOGEOGRAPHIC ZONE | NAME OF PROTECTED AREA | MUNICIPALITY | PROVINCE | REGION | AREA (ha) | PROCLAMATION NO. | PROCLAMATION DATE |
|---|---|---|---|---|---|---|---|
| B | 1. Ambuklao-Binga | Atoc, Bokod | Mt. Province | CAR | 63,650 | 548 | 4/19/69 |
| | 2. Ambuklao | Atoc, Bokod | Mt. Province | CAR | 9,700 | 120 | 11/25/66 |
| | 3. Lower-Agno | San Manuel, San Nicolas | Baguio City | CAR | 39,304 | 2320 | 11/22/83 |
| | 4. Busol | Baguio City and La Trinidad | Benguet | CAR | 337 | 15 | 4/14/22 |
| | 5. Marcos Highway | Tuba | Benguet | CAR | 6,105 | 1754 | 6/22/78 |
| C | 1. Infanta | Infanta | Quezon | 4 | 384 | 158 | 2/13/67 |
| | 2. Polillo | Polillo | Quezon | 4 | 130 | 72 | 8/9/66 |
| | 3. Mulawin Spring | Guinayangan | Quezon | 4 | 204 | 365 | 1/2/39 |
| | 4. Lopez | Lopez | Quezon | 4 | 418 | 566 | 6/22/40 |
| | 5. Calabagan | Casiguran | Aurora | 4 | 4,803 | 915 | 6/1/92 |
| | 6. Dipaculao | Dipaculao | Aurora | 4 | 1,786 | 116 | 6/10/87 |
| | 7. Dinadiawan River | Dipaculao | Aurora | 4 | 3,387 | 918 | 6/9/92 |
| | 8. Alabat | Alabat | Quezon | 4 | 688 | 156 | 9/18/87 |
| | 9. Aurora | Baler | Quezon | 4 | 430 | 34 | 2/4/36 |
| | 10 Tibiang-Damagandong | Quezon | Quezon | 4 | 280 | 295 | 7/21/38 |
| | 11. Amro River | Casiguran and Dilasag | Aurora | 4 | 6,470 | 633 | 8/28/90 |
| | 12. Talaytay River | Dinalungan | Aurora | 4 | 3,626 | 370 | 12/3/90 |
| | 13. Binahaan River | Pagbilao & Manban | Quezon | 4 | 465 | 735 | 5/29/91 |
| | 14. Simbahan-Talagas River | Dingalan | Quezon | 4 | 2,266 | 905 | 5/22/92 |
| | 15. Dibalo-Pingit-Zibali-Malayat | Baler & San Luis | Aurora | 4 | 4,528 | 908 | 5/25/92 |
| D | 1. Ilocos Norte Metro | Pasuquin | Ilocos Norte | 1 | 2,934 | 731 | 9/7/34 |
| | 2. Magnuang | Batac | Ilocos Norte | 1 | 152 | 220 | 7/2/67 |
| | 3. Libunao Spring | Sinait | Ilocos Sur | 1 | 47 | 410 | 10/2/51 |
| | 4. Bighiga Spring | Narvacan | Ilocos Sur | 1 | 135 | 431 | 8/16/39 |
| | 5. Santa | Santa | Ilocos Sur | 1 | 25 | 844 | 9/26/35 |
| | 6. Lidlidda | Lidlidda | Ilocos Sur | 1 | 1,228 | 79 | 9/17/36 |
| | 7. Sta. Lucia | Sta. Lucia | Ilocos Sur | 1 | 174 | 333 | 10/18/38 |
| | 8. Naguilian | Naguilian | La Union | 1 | 90 | 52 | 4/11/36 |
| | 9. Tanap | Burgos | Ilocos Norte | 1 | 41 | 83 | 2/1/71 |
| | 10. Casecnan River | Dupax del Norte and del Sur | N. Vizcaya | 2 | 85,219 | 136 | 8/11/87 |
| | 11. Dupax | Dupax | N. Vizcaya | 2 | 425 | 720 | 8/8/34 |
| | 12. Bawa | Gonzaga and Lal-lo | Cagayan | 2 | 8,955 | 108 | 5/13/87 |
| | 13. Wangag | Gonzaga and Lal-lo | Cagayan | 2 | 6,992 | 107 | 5/13/87 |
| | 14. Angat Watershed Metro Water District | Montalban, San Jose Norzagaray, San Rafael, Infanta | Rizal, Bulacan Nueva Ecija | 3 | 55,707 | 71 | 2/10/27 |
| | 15. Pantabangan-Carranglan | Pantabagan, Carranglan | Nueva Ecija | 3 | 84,500 | 561 | 5/21/69 |
| | 16. Angat Watershed and Forest Range (Pilot) | Norzagaray, San Jose Montalban | Bulacan, Rizal | 3 | 6,600 | 391 | 4/30/68 |
| | 17. Talavera | Sta. Fe, Carranglan, Lupao, San Jose | Nueva Ecija, N. Vizcaya | 3, 2 | 37,295 | 350 | 12/12/38 |
| | 18. Doña Remedios/General Tinio | Doña Remedios, Gen. Tinio | Bulacan, Nueva Ecija | 3 | 20,760 | 230 | 2/23/88 |
| | 19. Marikina (Amended) | Antipolo, Montalban | Rizal | 4 | 18,966 | 2480 | 1/29/86 |
| | 20. Mulanay | Mulanay | Quezon | 4 | 26 | 296 | 7/21/38 |
| | 21. Buenavista | Mulanay | Quezon | 4 | 356 | 166 | 6/27/37 |
| | 22. Torrijos | Torrijos | Marinduque | 4 | 105 | 463 | 4/6/32 |
| | 23. Calauag | Calauag | Quezon | 4 | 328 | 367 | 1/2/39 |
| | 24. Catanduanes | Virac, Bato, San Miguel | Catanduanes | 5 | 26,010 | 123 | 6/23/87 |
| | 25. Lagonoy | Lagonoy | Camarines Sur | 5 | 470 | 500 | 9/26/32 |
| | 26. Bahican | Mabulao | Camarines Norte | 5 | 44 | 592 | 6/23/33 |

*Cont'n.* **Table 69**

| BIOGEO-GRAPHIIC ZONE | NAME OF PROTECTED AREA | MUNICIPALITY | PROVINCE | REGION | AREA (ha) | PROCLAMATION NO. | PROCLAMATION DATE |
|---|---|---|---|---|---|---|---|
| | 27. Capalonga | Capalongan | Camarines Norte | 5 | 752 | 120 | 11/25/66 |
| | 28. Abasig-Matogdon-Manang (Amendment) | Labo, San Lorenzo Ruiz and San Vicente | Camarines Norte | 5 | 5,545 | 836 | 11/18/91 |
| E | 1. Watershed Purposes of Mariveles (Palanas) | Mariveles | Bataan | 3 | 325 | | 2/25/19 |
| | 2. Olongapo | Olongapo | Zambales | 3 | 6,424 | 66 | 3/20/87 |
| G | 1. Calatrava, San Andres, San Agustin | Calatrava, San Andres, San Agustin | Romblon | 4 | 2,670 | 2186 | 4/29/82 |
| | 2. Pan-ay River | Tapaz | Capiz | 6 | 4,350 | 599 | 6/28/90 |
| | 3. Aklan River | Madalag & Libucao | Aklan | 6 | 23,185 | 600 | 6/28/90 |
| | 4. Jalaur River | Calinog | Iloilo | 6 | 9,228 | 601 | 6/28/90 |
| | 5. Ilog-Hilabangan | Himamaylan & Kabankalan | Negros Occidental | 6 | 10,211 | 602 | 6/28/90 |
| | 6. Dalanas River | Barbaza | Antique | 6 | 8,558 | 603 | 6/28/90 |
| | 7. Bago River | Talisay, Murcia, Don Salvador, Benedicto Calatrava | Negros Occidental | 6 | 61,926 | 604 | 6/28/90 |
| | 8. Tipulu-an Mau-it River Watershed | Sibalom | Antique | 6 | 7,737 | 605 | 6/28/90 |
| H | 1. Loboc | Balilihan, Bilar, Butuan, | Bohol | 7 | 19,410 | 450 | 12/23/53 |
| | 2. Alijawan-Cansuhay-Anibongan River | Duero, Jagna | Bohol | 7 | 3,650 | 881 | 3/20/92 |
| | 3. Pan-as Falls Hay-ban | Catarman & Calbayog City | Samar | 8 | 7,832 | 318 | 12/15/67 |
| | 4. Palompon | Palompon, Villaba | Leyte | 8 | 2,392 | 212 | 1/29/88 |
| | 5. Jicontol | Dolores & Canovid | Eastern Samar | 8 | 7,390 | 882 | 3/26/92 |
| I | 1. Mananga River (amendment) | Talisay, Minglanilla, | Cebu | 7 | 6,823 | 581 | 5/29/90 |
| K | 1. Palawan Flora & Fauna | Puerto Princesa City | Palawan | 4 | 4,776 | 2221 | 7/14/82 |
| | 2. Bacuit | Bacuit | Palawan | 4 | 94 | 785 | 3/28/35 |
| | 3. Palawan Flora & Fauna (parcel 2) | Puerto Princesa City | Palawan | 4 | 3,224 | 2425 | 11/22/85 |
| M | 1. Pasonanca | Zamboanga City | Zamboanga del Norte | 9 | 10,560 | 199 | 12/17/87 |
| | 2. Buug | Buug | Zamboanga del Sur | 9 | 108 | 81 | 8/9/66 |
| | 3. Siocon | Siocon | Zamboanga del Norte | 9 | 612 | 155 | 9/18/87 |
| N | 1. Muleta-Manupali | Lantapan & Pangantukan | Bukidnon | 10 | 61,500 | | |
| | 2. Mt. Malindang NP & Watershed* | Oroquieta, Ozamis City, Calamba, Bonifacio Jimenez | Misamis Occidental and Zamboanga | 10 | 53,262 | R.A. 6266 | 6/19/71 |
| | 3. Malisbilisan Falls | Talisayan | Misamis Oriental | 10 | 72 | 51 | 4/11/36 |
| | 4. Mahoganao | Caoayan | Misamis Oriental | 10 | 136 | 470 | 4/29/32 |
| | 5. Surigao | Surigao City | Surigao del Norte | 13 | 967 | 635 | 8/29/90 |
| | 6. Andanan River | Sibagat & Bayugan | Agusan del Sur | 13 | 15,097 | 734 | 5/29/91 |
| | 7. Cabadbaran | Cabadbaran | Agusan del Norte | 13 | 16,025 | 834 | 11/13/91 |
| | 8. Malagos | Guingana | Davao | 11 | 235 | 612 | 8/21/33 |
| | 9. Allah | Isulan, Banga, Surallan Giamba | South Cotabato | 11 | 92,450 | 2455 | 9/24/85 |
| | 10. Sebu | Banga & Kiamba | South Cotabato | 11 | 9,900 | 65 | 8/4/66 |
| | 11. Mati | Mati | Davao | 11 | 890 | 222 | 7/26/67 |
| | 12. South Upi | South Upi | North Cotabato | 12 | 1,894 | 65 | 6/20/87 |
| | 13. Libungao | Libungan and Alamada | Cotabato | 12 | 52,820 | 563 | 5/3/90 |
| | 14. Lake Lanao | | Lanao del Sur | ARMM | 180,460 | 871 | 2/26/92 |
| | 15. Baganga | Baganga | Davao Oriental | 11 | 114 | 195 | 12/8/87 |

**Proclaimed both as National Park and Watershed Reserve*

Source: PAWB, 1997 August

***Table 70** Mangrove swamp forest reserves under Proclamation 2152, S. 1981*

| | NAME | COORDINATES | LOCATION | REGION |
|---|---|---|---|---|
| 1 | Entire Province of Palawan [1] | | Palawan | 4 |
| 2 | Palsabangan River up to Mazintuto River | Long. 12°42'44" to 121°44'16"<br>Lat. 13°58'10" to 13°59'19" | Tayabas Bay, Quezon | 4 |
| | Bacong River up to Sandoval Point | Long. 122°11'43" and Lat. 13°37'48"<br>Long. 122° 17'05" and Lat. 13°34'26"<br>Long. 122°17'40" and Lat. 13°36'28" | | |
| | Palay Point up to Mulanay River, Bondoc Peninsula | Long. 122°19'36" and Lat. 13°34'00"<br>Long. 122°19'41" and Lat. 13°337'36"<br>Long. 122°21'57" and Lat. 13°33'30"<br>Long. 122°23'50" and Lat. 13°31'10 " | | |
| | Bondoc River in Aurora up to Pinamutangan Point, Bondoc Peninsula | Long. 122°30'00" and Lat. 13°14'25 "<br>Long. 122°31'50" and Lat. 13°20'58 " | | |
| | San Andres to Arena Point, Bondoc Peninsula | Long. 123°46'00" and Lat. 13°15'5" | | |
| 3 | Islands of Polillo, Alabat, Cabalete, Jomalig Patnanonga, Kalotkot, Kalongkooan, Palasan, Calabao, Icol and San Rafael | | Lamon Bay, Quezon | 4 |
| 4 | Islands of Sta. Cruz and Salomaque | | Marinduque | 4 |
| | Foreshoreline of Bo. Dapdap and Alabo up to the mouth of Tagum River | Long. 122°04'12" and Lat. 13°27'45"<br>Long. 122°04'27" and Lat. 13°28'25"<br>Long. 122°07'01" and Lat. 13°29' | | |
| | Malinao Creek up to Salomaque Point | Long. 122°06'42" and Lat. 13°23'12"<br>Long. 122°08'42" and Lat. 13°22'18" | | |
| | Foreshoreline of Bo. Cabuyagan to the eastern side of Dating Bayan River in Calancan Bay | Long. 121°58'20" to 122°03'00"<br>Lat. 13°30'28" | | |
| 5 | Sibuyan Island[2] | | | 4 |
| 6 | Mangrove areas along the banks of Mamburao River | Long. 120°35' to 120°36'14"<br>Lat. 13°13'32" to 13°14'29" | Mindoro | 4 |
| | Buluagan River to Lagarum River, Naujan | Long. 121°17'42" to 121°20'17"<br>Lat. 13°17'8" to 13°20' | | |
| | Mangrove areas in the banks of Batel Creek, Sta. Cruz | Long. 120°42'35" to 120°44'5"<br>Lat. 13°4'14 to 13°6'29" | | |
| | Sablayan Point up to the mouth of Bagong Sabang River | Long. 120°45'31" to 120°46'0"<br>Lat. 12°44'38 to 12°50'34" | | |
| | Bo. Labangan to Calalayuan Point, Ilin Island | Long. 121°2'42" to 121°4'32"<br>Lat. 12°18'14" to 12°17'19" | | |
| | Mangroves at the western side of Sukol River Bongabong | Long. 121°28'21" to 121°29'26"<br>Lat. 12°45'00" to 12°42'20" | | |
| | Mangroves at the western side of Casiliga River Island of Soguicay | | | |
| 7 | Mangrove areas from Del Pilar River to Palita Island, Bo. Salvacion and Dahican | Long. 122°23'25" and Lat. 14°16'08" | Camarines Norte | 5 |
| 8 | Tanglar Point to Bicol River | Long. 122°14'24" and Lat. 13°44'42"<br>Long. 123°07'12" and Lat. 13°44'00" | Camarines Sur | 5 |
| | Mangroves along the banks of Looc River | Long. 123°18'57" and Lat. 13°54'25"<br>Long. 123°21'10" and Lat. 13°59'00" | | |
| | Mangrove areas of Port Tambang including banks of Tambang River and Olas River | Long. 123°24'40" and Lat. 13°54'00"<br>Long. 127°27'56" and Lat. 13°57'28" | | |
| | Mangroves in Bo. Gibgos and Tabaon | Long. 123°5'56" and Lat. 13°50'00"<br>Long. 123°46'00" and Lat. 13°53'40"<br>Long. 123°48'20" and Lat. 13°53'39" | | |

*Cont'n.* ***Table 70***

| | NAME | COORDINATES | LOCATION | REGION |
|---|---|---|---|---|
| | Mangroves along the banks of Salog River | Long. 123°42'50" and Lat. 13°52'00"<br>Long. 123°41'30" and Lat. 14°03'30" | | |
| | Mangroves along the banks of Delchi River, Buang Creek and Parusan River in Inuran and Sapitan Bay | Long. 123°15'00" and Lat. 14°00'00"<br>Long. 123°17'30" and Lat. 14°03'30" | | |
| | Mangroves along the banks of Sagnay River | Long. 123°31'20" and Lat. 13°35'48"<br>Long. 123°31'25" and Lat. 13°36'20" | | |
| | Quinabucasan Point to San Vicente Bay | Long. 123°19'39" and Lat. 14°00'28"<br>Long. 123°22'00" and Lat. 14°05'00" | | |
| | Northern Bank of Caima River up to Bo. Binahian | Long. 122°52'35" and Lat. 13°40'57"<br>Long. 122°51'19" and Lat. 13°54'09" | | |
| | Caragaray Pass to Gimbal Pt. in Caragay Island | Long. 127°27'56" and Lat. 13°57'28"<br>Long. 123°52'41" and Lat. 13°20'40" | | |
| | Islands of Lahay, Lucsuhin, Haponan, Quinabungan, Malabungot, Lamit and Batan | 13°17'50" | | |
| 9 | Pigbucan to Paron Point | Long. 123°50'57" and Lat. 123°54'08" | Manito, Albay | 5 |
| 10 | Putiao River to Malbog River | Long. 123°40'33" and Lat. 12°55'<br>Long. 123°41'30" and Lat. 12°58'40"<br>Long. 123° and Lat. 13°00' | Sorsogon | 5 |
| | Getumbro Point up to the Municipality of Sorsogon | Long. 123°55'30" and Lat. 124°00'<br>Lat 12°57'12" and Lat. 12°59'12" | | |
| | Malazimbo Point to the Municipality of Juban in Sorsogon Bay | Long. 123°55'28" and Lat. 12°50'35"<br>Long. 124°00' and Lat. 12°55'24" | | |
| | Mangroves along the banks of Dansol River | Long. 123°50'57" and Lat. 123°54'08" | | |
| | Papucha Point in Sugot up to Bo. Quidolog, Prieto Diaz boundaries divided into 2 quadrants:<br>(a) Sta. Lucia to Buenavista<br>(b) Buenavista to Dingay Point | <br><br>Long. 124°03'39" to 124°06'15"<br>Long. 124°04'10" to 123°12'35"<br>Lat. 123°50'57" to 13°04'47" | | |
| | Panuntingan Point in Gubat up to Tagdon River in Barcelona | Long. 124°55'24" to 12°24'39"<br>Long. 124°05'40" to 124°09'07"<br>Lat. 12°55'24" to 12°57'10" | | |
| | Sinagatan Bay to Mantay Point in Ginablan | Long. 124°44' to 124°06'15" | | |
| 11 | Malaquing River up to Mabung River | Long. 123°08'28" to 123°11'52"<br>Lat. 12°54'23" to 13° | Burias Island | 5 |
| | Cueva Point up to Kimartines Point | Long. 124°04'10" to 123°12'35"<br>Lat. 13°4'25" to 13°7'19" | | |
| | Kabugao Point up to Kabalong Andang Point | Long. 123°08'53" to 123°12'17"<br>Lat. 12°53'44" to 13°01'19" | | |
| 12 | Basin Island | | (near Burias Island) | 5 |
| 13 | Panciscan Point in Bitos Bay up to Bano Sanlay | Long. 123°48' to 123°46'43"<br>Lat. 12°21'25" to 12°23'30" | Masbate | 5 |
| | Panicijan River in Bunan Bay | Long. 123°45'28" to 123°46'43"<br>Lat. 12°24'30" to 12°25'19" | | |
| | Mangroves along the banks of Sta. Rosa River in San Jacinto town | Long. 123°41'49" to 123°43'14"<br>Lat. 12°34'6" to 12°35' | | |
| | Mangroves between Bo. Tamosa and Bagasico | Long. 123°40' to 123°41'51"<br>Lat. 12°37'53" to 12°38'39" | | |
| | Magdanay Point up to Taguictic Point | Long. 123°18'29" to 123°20'<br>Lat. 12°28'21" to 12°25'16" | | |
| | Bo. Magdangay to Malobago, Port Barrera | Long. 123°20' to 123°21'51"<br>Lat. 12°28'21" to 12°33'30" | | |

*Cont'n.* ***Table 70***

| | NAME | COORDINATES | LOCATION | REGION |
|---|---|---|---|---|
| | Guinobatan River up to Bariis | Long. 123°21'51" to 123°23'13"<br>Lat. 12°28'39" to 12°31'8" | | |
| | Bayuar Cove to Tinago Cove | Long. 123°24'11" to 123°25'19"<br>Lat. 12°31'6" to 12°31'30" | | |
| | Mangroves along the banks of Pasil River, Magdalena | Long. 123°31'44" to 123°32'32"<br>Lat. 12°26'29" to 12°27'30" | | |
| | Mangroves in Toos Cove in Mandaon | Long. 123°12'58" to 123°15'19"<br>Lat. 12°13'53 to 12°15'32" | | |
| | Bagupantao Point to Amutag Point | Long. 123°15'34" to 123°17'58"<br>Lat. 12°22'24" to 12°27'52" | | |
| | Mangrove areas along the banks of Daraga River | | | |
| | Mangrove areas from Diutag River to Lomocab River | Long. 124°13'31" to 124°15'16"<br>Lat. 11°57'18" to 11°54'59" | | |
| | Island of Caroga | | | |
| 14 | Islands of Ponson, Poro, Pacihan | | Camotes Sea, Bohol | 7 |
| 15 | Islands of Pamasuan, Handayan and Majanay | | Camotes, Bohol | 7 |
| | Islets of Banoon and Lapinig Chico | | | |
| | Mangrove areas east of Soom River to Pampang | Long. 124°25'84" to Lat. 10°5'35"<br>Lat. 10°2'2" to 10°36'00" | | |
| 16 | Islands of Ambugan, Pangangan, Cabilao and Sandingan | | Cebu Strait, Bohol | 7 |
| | Islet of Batas | | | |
| | Mangrove areas east of Inabanga River to Bo. Pampang | Long. 125°07'00" to Lat. 10°2'2" | | |
| 17 | Mangrove areas from Agio Point up to the municipality of Cambuyao | | Mindanao Sea, Bohol | 7 |
| | Mangrove areas from Bo. Biabas to Bo. Ondol including Bo. Condray, and Juagdan except the Island of Tintiman which is a Mangrove Wilderness area | Long. 124°32'58" to 124°36'<br>Lat. 9°56'48" to 9°59'18" | | |
| | Basiao Point up to Kasag Point at Lapinig | Long. 124°33' and Lat. 10°03'24"<br>Long. 124°36'18" to 10°05'24" | | |
| 18 | Island of Panglao | | Mindanao Sea, Bohol | 7 |
| | Mangrove areas from the west of Loboc River to the municipality of Laya | Long. 123°56'09" and Lat. 9°40'40" | | |
| 19 | Mangrove areas along the coastline of Dupon Bay from Sacay Point up to the mouth of Dupon River | Long. 124°24'20" to Lat. 10°54'42"<br>Long. 124°26'02" to 10°54'42"<br>Long. 124°24'20" to Lat. 10°57'21"<br>Long. 124°26'02" to 10°57'21" | Leyte | 8 |
| | Apali Point to Calunangan Point | Long. 124°28'24" to 124°30'54"<br>Lat. 10°52'12" to 10°52'24" | | |
| | Puerto Bello to Lao | Long. 124°31'20" to Lat. 10°58'36"<br>Long. 124°33'48" to 11°1'30" | | |
| | Mangrove areas from Bo. Tuban and Bo. Manpagui in Santa Cruz | Long. 124°47' to 124°48'42"<br>Lat. 11°21'47" to 11°23'36" | | |
| 20 | Mangrove areas from the municipality of Tagalisay to the mouth of Tigbao River including east of Vitali island | Long. 122°16'00" and Lat. 7°25'00"<br>Long. 122°22'00" and Lat. 7°18'00" | Sibuguay Bay, Zamboanga del Sur | 9 |
| 21 | Mangrove areas from Liangan River up to Lipatan River of the municipality of Lapayan | | Lanao del Norte | 10 |
| 22 | Bo. Bagumbang to Malautan River | Long. 123°39'41" to 123°49'19"<br>Lat. 8°01'53" to 8°8'14" | Ozamis City, Misamis Occidental | 10 |

*Cont'n.* ***Table 70***

| | NAME | COORDINATES | LOCATION | REGION |
|---|---|---|---|---|
| 23 | Mangrove areas from Baculin Point to Lakud Point | Long. 126°34'12" to Lat.°"17'26"43<br>Lat. 7°26'43" to 7°34'39" | Davao | 11 |
| | Mangrove areas fromTanuip Point in Banao to Kinablangan Island | Long. 126°32'16" to 126°34'49"<br>Lat. 7°41'49" to 7°43'50" | | |
| | Island of Samal | | | |
| 24 | Islands of Siargao, Bucas Grande, Middle Bucas and East Bucas in Dinagat | Long. 126°32'16" to 126°34'49"<br>Lat. 7°41'49" to 7°43'50" | Dinagat Sound, Surigao del Norte | 13 |
| 25 | Island of Dianagat, Hikdop, Sibale, Hanigad | | Surigao Strait, Surigao del Norte | 13 |
| 26 | Mangrove areas along the municipalities of Lavigan and Valencia up to Taon River of the municipality of Barcelona | Long. 126°25'24" to 126°30<br>Lat. 8°10' to 8°15' | Surigao del Sur | 13 |
| | Islands of Masopelid, Mahaba, Condona, Bayagnan, Bilabid and Caye | | | |
| 27 | Mangrove areas in Tumalong Bay, Baong River and Pongao Bay | | Zamboanga del Sur | ARMM |
| | Mangrove areas from Malubog Point up to the municipality of Sambalawan including the Island of Pisan | Long. 123°21'36" to 123°28'8"<br>Lat. 7°33'10: to 7°38'10" | | |
| | Islands of Sagayapan, Tintauan and Sacol | | | |

*[1]Also proclaimed as Game Refuge and Bird Sanctuary; covers other protected area sites*
*[2]Covers Mt. Guiting-Guiting Natural Park*

Source: PAWB, 1997 August

***Table 71*** *Islands proclaimed as tourist zones and marine reserves under Proclamation No. 1801, S. 1978*

| | NAME OF PROTECTED AREA | MUNICIPALITY | PROVINCE | REGION |
|---|---|---|---|---|
| 1 | Fuga Island | | Cagayan | 2 |
| 2 | Fortune Island | | Batangas | 4 |
| 3 | Maricaban Island | | Batangas | 4 |
| 4 | Gaban Island | | Batangas | 4 |
| 5 | Sombrero Island | | Batangas | 4 |
| 6 | Ligpo Island | | Batangas | 4 |
| 7 | Malahibong Manok | | Batangas | 4 |
| 8 | Verde Island | | Batangas | 4 |
| 9 | Port Galera | Puerto Galera | Oriental Mindoro | 4 |
| 10 | Balatero Cove | Puerto Galera | Oriental Mindoro | 4 |
| 11 | Medio Island | Puerto Galera | Oriental Mindoro | 4 |
| 12 | Buyayao Island | Bulalakao | Oriental Mindoro | 4 |
| 13 | Aslom Island | Bulalakao | Oriental Mindoro | 4 |
| 14 | Bating Peninsula | Bulalakao | Oriental Mindoro | 4 |
| 15 | Maasim Island | Bulalakao | Oriental Mindoro | 4 |
| 16 | Balatasan Cove | Bulalakao | Oriental Mindoro | 4 |

*Cont'n.* ***Table 71***

| | NAME OF PROTECTED AREA | MUNICIPALITY | PROVINCE | REGION |
|---|---|---|---|---|
| 17 | Pocanel Island | Bulalakao | Oriental Mindoro | 4 |
| 18 | Opao Island | Bulalakao | Oriental Mindoro | 4 |
| 19 | Buyallao Peninsula | Bulalakao | Oriental Mindoro | 4 |
| 20 | Suguicay Island | Bulalakao | Oriental Mindoro | 4 |
| 21 | Libago Island | Bulalakao | Oriental Mindoro | 4 |
| 22 | Sibalat Island | Bulalakao | Oriental Mindoro | 4 |
| 23 | Pambaron Island | Bulalakao | Oriental Mindoro | 4 |
| 24 | Apo Reef Island [1] | Bulalakao | Oriental Mindoro | 4 |
| 25 | Busuanga Island | | Palawan | 4 |
| 26 | Coron Island | | Palawan | 4 |
| 27 | Puerto Princesa & surrounding areas | | Palawan | 4 |
| 28 | Malampaya Sound and Islands | | Palawan | 4 |
| 29 | Canaron Island | | Palawan | 4 |
| 30 | Solitario Island | | Palawan | 4 |
| 31 | Bacuit Bay Island [2] | | Palawan | 4 |
| 32 | Balabac Island | | Palawan | 4 |
| 33 | Fort Bunton | | Palawan | 4 |
| 34 | Busuanga Island | | Palawan | 4 |
| 35 | Boracay Island | Aklan | Aklan | 6 |
| 36 | Apo Island 3 | Dumaguete | Negros Oriental | 7 |
| 37 | Siquijor Island | Dumaguete | Negros Oriental | 7 |
| 38 | Selinog Island (Between Negros and Cebu) | Dumaguete | Negros Oriental | 7 |
| 39 | Aligway Island | Dumaguete | Negros Oriental | 7 |
| 40 | Gaubian Island and vicinity | SEA of Mactan | Cebu | 7 |
| 41 | Olango Island [4] | Pangan | Cebu | 7 |
| 42 | Buyong Beach | Maribago, Mactan | Cebu | 7 |
| 43 | Sogod | North of Cebu City | Cebu | 7 |
| 44 | Panglao Island | Tagbilaran | Bohol | 7 |
| 45 | Cabilao Island | Tagbilaran | Bohol | 7 |
| 46 | Balicasag Island | Tagbilaran | Bohol | 7 |
| 47 | Gigantangan Island | NW tip of Leyte | Tacloban | 7 |
| 48 | Guiuan [3] | Eastern Samar | Tacloban | 8 |
| 49 | Big and small Sta. Cruz Island[5] | Sta. Cruz | Zamboanga | 9 |
| 50 | Sangali Cove | | Zamboanga | 9 |
| 51 | Sacol Island | | Zamboanga | 9 |
| 52 | Ayala/San Ramon | | Zamboanga | 9 |
| 53 | Malanipa Island | | Zamboanga | 9 |
| 54 | Al-Sulnuan Point | West of Cagayan de Oro City | Misamis Oriental | 10 |
| 55 | Camiguin Island | Cagayan de Oro City | Misamis Oriental | 10 |
| 56 | Maliputo Island-Talicud Island | | Davao | 11 |
| 57 | Ligig Island | | Davao | 11 |
| 58 | Eastern side of Samal Island | | Davao | 11 |

[1] *Newly proclaimed Marine Natural Park (priority site under WB-GEF Project)*
[2] *Covers El Nido Marine Reserve proclaimed by virtue of DAO No. 14 series of 1991*
[3] *Proclaimed as Protected Landscape/Seascape by virtue of Proclamation 439 dated August 9, 1994 and Proclamation 469 dated September 26, 1994*
[4] *Also proclaimed as GRBS by virtue of Proclamation 920 dated may 14, 1992, RAMSAR Site*
[5] *Also proclaimed as a National Park under Proclamation No. 654 dated February 4, 1975*

***Table 72*** *Protected Areas declared through Administrative and Memorandum Orders*

| BIOGEOGRAPHIC ZONE | | NAME | CATEGORY | REGION | LOCATION | AREA (hectares) | DATE | LEGISLATION |
|---|---|---|---|---|---|---|---|---|
| C | 1 | Minasawa Island | Game Refuge and Bird Sanctuary | 4 | Pamanongan, Quezon | 4 | 9 15 64 | P&W Adm. Order No. 7 |
| G | 2 | El Nido | Marine Reserve | 4 | El Nido, Palawan | 95,000 | | |
| | 3 | Sampunong Bolo | Game Refuge and Bird Sanctuary | 6 | Juaneza, Sara, Iloilo | 52 | 1987 | REID's Adm. Order No. 25 |
| | 4 | Lake Danao | Game Refuge and Bird Sanctuary | 7 | San Francisco, Pacijan Island Camotes Group, Cebu | 480 | 12 24 65 | Adm. Order No. 1 |
| H | 5 | Imelda Lake (Lake Danao) | Tourist Resort | 8 | Ormoc City, Leyte | 2195 | 6/2/72 | Memorandum to DANR from the Office of the President |
| I | 6 | Panagatan | Marine Turtle Sanctuary | 6 | Antique | | 6/8/82 | MNR Admin Order No. 8 |
| K | 7 | Ursula Island | Game Refuge and Bird Sanctuary | 4 | Bataraza, Palawan | 20 | 4/30/60 | Adm. Order No. 14 |
| | 8 | Halog Island | Marine Turtle Sanctuary | 4 | Palawan | | 6/8/82 | MNR Admin Order No. 8 |
| | 9 | Limoboan Island | Marine Turtle Sanctuary | 4 | Palawan | | 6/8/82 | MNR Admin Order No. 8 |
| | 10 | Panata Cay | Marine Turtle Sanctuary | 4 | Palawan | | 6/8/82 | MNR Admin Order No. 8 |
| | 11 | Kota Island | Marine Turtle Sanctuary | 4 | Palawan | | 6/8/82 | MNR Admin Order No. 8 |
| O | 12 | Bancauan Island | Marine Turtle Sanctuary | 12 | Tawi-Tawi | | 6/8/82 | MNR Admin Order No. 8 |
| | 13 | Baguan Island | Marine Turtle Sanctuary | 12 | Tawi-Tawi | | 6/8/82 | MNR Admin Order No. 8 |
| | 14 | Liguasan marsh | Game Refuge and Bird Sanctuary | 12 | Dulawan, Liguasan South Cotabato | 30,000 | 12 1 36 | FAO Adm. Order No. 19 |
| Total | 14 | | | | | 127,749+ | | |

*Source: PAWB, 1997 August*

The identified virgin forests before the passage of the NIPAS law are part of the initial components of the system. In 1988, NAMRIA reported that a total of 1,178,000 hectares of old growth forests (OGF)/ virgin forests remained in the country. Because the NIPAS law only referred to virgin forests, there is a need to determine from the 1.2 million hectares, the extent and location of the virgin forests. Other protected areas such as those covered by proclamation 1801 or declared through administrative/ memorandum orders may likewise be considered as additional areas for inclusion in the new system.

The biodiversity profiles of the first ten protected areas selected for the initial implementation of the NIPAS law and funded by the Global Environment Facility (GEF) are presented in the IPAS Final Report (1992). It should be noted that the faunal inventory, in general, does not include all groups but concentrated on the most predominant ones.

### 2.5.2. Species and Ecosystem Diversity in Protected Areas

A. Batanes Protected Landscapes and Seascapes (BPLS)

Mount Iraya is the principal watershed of the Island. At an altitude of 50-100 m.a.s.l. is a dense thicket composed of species characteristic of regenerating or disturbed primary forest. The species found in this area are: *Pterocarpus indicus, Boerlagiodendron pectinatus, Neonauclea reticulata, Villebrunnea trinervis* (abundant), *Mallotus ricinioides* (abundant), *Homalium multiflorum* (few), *Radermachera fenicis, Wendlandia luzonensis* (few), *Ficus garcis* (few), *Cyathea ilepifera, Stephania japonica* (few), *Deeringia polysperma* (few), *Cynanchum linkiuense* (few), *Cyclea insularis var, luxurians* (few). A dense mat of the giant reed

***Table 73*** *Newly proclaimed protected areas under NIPAS category*

| NAME | LOCATION | REGION | LEGISLATION | DATE | AREA (Hectare) | SPECIAL FEATURES/ REMARKS |
|---|---|---|---|---|---|---|
| 1 Peñablanca Protected Landscape/Seascape[1] | Peñablanca, Cagayan | 2 | Proc. 827<br>Proc. 416 | 7/16/35<br>6/29/94 | (192)<br>4,136 | Multi-chambered caves; deep canyons rock formations; beautiful stream; and recreational resort. |
| 2 Palaui Island Protected Landscape/Seascape | Sta. Ana, Cagayan | 2 | Proc. 447 | 8/16/94 | 7,415 | Terrestrial and Marine Ecosystem. |
| 3 Batanes Protected Landscape/Seascape | Batanes group of islands | 2 | Proc. 335 | 2/28/94 | 213,578 | Terrestrial and Marine Ecosystem |
| 4 Northern Sierra Madre National Park | Palanan, Dinilacan, Maconacon, Ilagan, San Mariano, Dinapigue and Isabela | 2 | Proc. 978 | 3/10/97 | 319,513<br>247,861 (land)<br>71,652 (water) | Terrestrial and Marine Ecosystem |
| 5 Masinloc-Oyon Bay Marine Reserves | Masinloc and Oyon, Zambales | 3 | Proc. 231 | 8/18/95 | 7,568 | Coastal and Marine Ecosystem Mangrove, seagrass and coral reefs. |
| 6 Pamitinan Protected Landscape | Rodriguez, Province of Rizal | 4 | Proc. 901 | 10/10/96 | 600 | Cave Ecosystem |
| 7 Taal Volcano Protected Landscape | Talisay, Malvar, Tanauan, Laurel Agoncillo, Santa Teresita, Cuenca Alitagtag, Mataas na Kahoy, Lipa City Balete and San Nicolas, Province of Batangas and Tagaytay City | 4 | Proc. 906 | 10/6/96 | 62,292 | Lake and volcanic ecosystem |
| 8 Apo Reef | Sablayan, Province of Occidental Mindoro | 4 | Proc. 868 | 9/6/96 | 15,792 | Marine Ecosystem |
| 9 Mt. Guiting-Guiting Natural Park[2] | Cajidocan, Magdiwang and San Fernando in Sibuyan Is. | 4 | Proc. 746 | 2/20/96 | 15,265.48 | Terrestrial Ecosystem |
| 10 Sagay Protected Landscapes/Seascape | Islands of Molacaboc, Diutay, Matabas & Suyag & surrounding reefs and reefs of Carbin and Maca | 6 | Proc. 592 | 6/1/95 | 28,300 | Terrestrial and marine ecosystems, mangroves, coral reefs and sea grass beds. |
| 11 Mt. Canlaon Natural Park[3] | Murcia and La Castellana, Bago, La Carlota, Canlaon and San Carlos | 6 | Proc. 1005 | 5/8/97 | 24,557 | Picturesque core of the active volcano, waterfalls, hotsprings, gorge, rock formations, virgin forest, mossy forest, lagoon, endemic wildlife. |
| 12 Apo Island Protected Landscape/Seascape[4] | Zamboangita, Negros Oriental | 7 | Proc. 439 | 8/9/94 | 691.45 | Coral reef ecosystems; terrestrial and marine ecosystem |
| 13 Chocolate Hills Natural Monument | Carmen, Bauan, Sabagan, Bohol<br>Bilar, Valencia and Sierra Balmes | 7 | Proc. 1037 | 7/1/97 | 1,776 | Karst landscape composed of numerous conical shaped hills standing on the average about 40, 80 and 120 meters above the plain and 100-500 meters above sea-level |
| 14 Guiuan Protected Landscape/Seascape[1] | Guiuan, Eastern Samar | 8 | Proc. 469 | 9/26/94 | 60,448 | Terrestrial and marine ecosystems, mangroves, coral reef, and seagrass beds. |
| 15 Mt. Kitanglad Natural Park[3] | Talakag, Baragon, Libona, Manolo, Fortich Sumilao, Impasug-ong, Malaybulay and Lantapan Province of Bukidnon | 10 | Proc. 896 | 10/24/96 | 29,716 | Habitat of the Philippine Eagle; Virgin dipterocarp and mossy forest composed of a range of mountains with features such as waterfalls, small mountain lake, caves and rock formations |
| 16 Pujada Bay Protected Landscape/Seascape | Mati, Davao Oriental | 11 | Proc. 431 | 7/13/94 | 21,200 | Coastal and marine ecosystems; seagrass, mangrove and coral reefs. |
| 17 Mt. Apo Natural Park | Kidapawan, Makilala, Magpet, Cotabato and Bengalen, Digos, Sta. Cruz, Davao del Sur and Davao City | 11 | Proc. 882 | 9/24/96 | 72,113 | |
| 18 Mt. Matutum Protected Landscape | Tupi, Tampakan and Polomonok, South Cotabato Malungon, Sarangani | 12 | Proc. 552 | 3/20/95 | 15,600 | Diverse biological resources |
| 19 Sarangani Bay Protected Seascape | Maituon, Kiamba and Maasin Sarangani | 12 | Proc. 756 | 3/3/96 | 215,950 | Marine Ecosystem |
| 20 Siargao Protected Landscape/ Seascape | Siargao, Province of Surigao del Norte | 10 | Proc. 902 | 10/10/96 | 278,914 | Wetlands ecosystem |
| 21 Agusan Marsh Wildlife Sanctuary | San Francisco, Bunawan, De Ruela, Loreto and Lapaz, Province of Agusan del Sur | 13 | Proc. 913 | 10/31/96 | 14,835.98 | A vast complex of freshwater marshes with numerous shallow lakes and ponds with the upper basin of the Agusan River and its tributaries |

*[1]Covers former Callao Cave National Park*
*[2]Part of Sibuyan Island Mangrove Forest Swamp Reserve*
*[3]Originally proclaimed as Natural Park*
*[4]Originally covered by Proclamation 1801*

*Source: PAWB, August 1997*

*Miscanthus sinensis* var. *condensatus* is found at the upper part of Mount Iraya.

Mount Matarem (459 m.a.s.l.), smaller than Mount Iraya, has a richer plant species composition and trees on its lower slopes are taller, reaching to 20 m or more. Several species such as *Ardisia confertiflora* and *Ficus nitida* are common on Mount Matarem but are rarely found on Mount Iraya.

Endemic birds in the BPLS include *Rallina curizonoides alverzi* from Batan; *Treron formosae filipina* from Camiguin, Batan, Sabtang, and Ibuhos Islands. Two newly described species of lizards, *Draco jarecki*, a flying lizard, and *Lepidodactylus balioburius*, a gecko, and an undescribed species of snake, *Lycodon*, are also found in Batan Island.

Coastal and marine plants are dominated by macrobenthic seaweeds. A total of 47 species, 20 species of green seaweeds (Chlorophyta), nine species of brown seaweeds (Phaeophyta), and 18 species of red seaweeds (Rhodophyta), are reported.

B. Northern Sierra Madre Natural Park (NSMNP)

The NSMNP has a high level of biodiversity due to its relatively pristine state that includes an equally diverse primary forest containing a variety of habitats. Its topographic and spatial variations and the influence of climate on its vegetation may have resulted in adaptations to a monsoonal type (with less pronounced dry season) than to a distinct dry and wet season found in other parts of the country. These conditions are conducive to speciation.

Endemic plants in the NSMNP include dipterocarps. *(Shorea spp.* and *Hopea spp.)*, orchids *(Dendrobium aclinia* and *Eulophia dentata)*, the leguminous trees *(Milletia longipes)* and a member of the citrus family, *Swinglea glutinosa*, an endemic genus.

The fauna includes a significant number of endemic species: Danielsen et al., 1991 reported that 75 of the recorded bird species are endemic to the Philippines and another 20 species are narrowly restricted to Luzon. An expedition in 1961 resulted in the collection of 94 species of birds and 16 species of mammals. A 1991 survey recorded 102 species of birds of which 21 are widespread Philippine endemics and 11 restricted to Luzon and satellite islands. Recorded for mammals are 21 species. There is meager information on reptiles and amphibians.

C. Subic-Bataan Natural Park (SBNP)

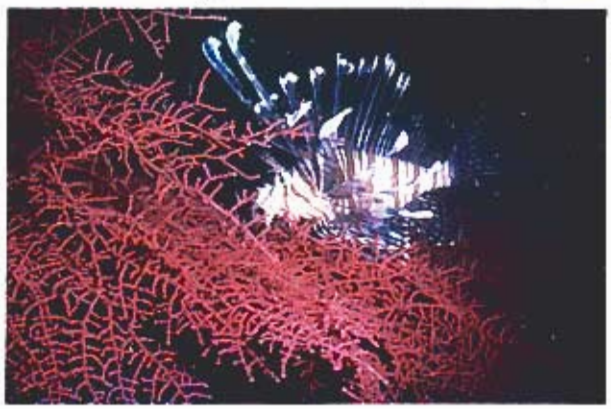
The SBNP is the site of the last vestiges of virgin forests in the Zambales Biogeographic Zone. Forest types include the lowland tropical evergreen rainforest situated at 100-900 m.a.s.l. and the upper montane tropical rainforest at 900-1250 m.a.s.l.

The lowland tropical evergreen rainforest is highly vulnerable to exploitation, because it harbors tree species of high commercial value such as palosapis *(Anisoptera thurifera)*, apitong *(Dipterocarpus grandiflorus)*, panao *(Dipterocarpus gracilis)*, dalindingan *(Hopea acuminata)*, white lauan *(Shorea contorta)*, guijo *(Shorea guiso)*, and tangile *(Shorea polysperma)*. The upper montane tropical rain forest trees have little commercial value but are important as protection forest, e.g. watershed protection. Endemic and highly interesting species include *Rhododendron guadrasianum* var *marivelesense* and *R. kochii* and *Vaccinium microphyllum* var. *whitfordii*, *V. tenuipes*, *V. cumingianum* var. *marivelesense*, *V. vumingianum* var *irogotum*, *V. alvarezii* var. *alvarezii*, *V. jarori*, *V. benguetense*, and *V. caudatum*.

D. Apo Reef Marine Natural Park (ARMNP)

The coral cover of ARMNP was estimated to be between 33-46 percent. The common genera noted were *Montipora*, *Acropora*, and *Porites*. A total of 19 scleractinian species and seven species of non-scleractinian reef building corals were reported on the lee side of the reef.

Nearly 380 species of fishes have been identified in the area, representing a part of the total reef fish community (BFAR Annual Report 1983). Fish



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inhabiting the reef include: damsel fishes, wrasses, butterfly fishes, groupers, gobie, angel fishes, blankness, parrot fishes, cardinal fishes, snappers and spinechecks, trigger fishes, fusiliers, siganids, squirrel fishes, jacks, and crevalles. Four species of sharks are commonly seen in deeper waters (white tip, black tip, hammerhead, and gray reef). Sting rays, mantas, giant bumphead parrot fishes, and wrasses are found in the reef crest and drop-off areas.

Invertebrates commonly found include various species of starfishes, holothurians, sea urchins, crinoids, sea squirts, brittle stars, worms, sponges, snails, nudibranches, clams, rare shells, octopi, and squids. These are found in habitats like the tidepools, reef flats, reef walls of drop-offs, and on sandy and rocky shores.

Twenty four species of birds including four species of terns, three species of pigeons and two species of kingfishers, egrets, sea eagles, and frigate birds are found in the area (BFAR, 1983; IUCN/UNEP 1988). Other wildlife species observed in the area were the hawksbill turtle, green sea turtle, and the Nicobar pigeon.

E. Mt. Canlaon Natural Park (MCNP)

The species of birds found in the MCNP with 50 species represented belong to 40 genera. Among these are *Cacomantis m. merulinus, Ninox philippensis centralis, Orthotomus castaneiceps rabori, Rhinomyias albiqularis, Ficedula westermanni rabori, Aethopyga siparaja magnifica,* and *Dicaeum p. pygmaeum.* Only 11 species of mammals were identified: five pteropodid bats, two murids, one felid, two viverrids, and one cervid; 18 species of reptiles and amphibians were recorded.

Four families of butterflies comprising 32 genera and 81 species were observed frequenting grasslands, cultivated areas, waterways, and forest interiors.

Very few endemic plants, such as *Crytandra cyclopum, Isachne vulcanica* and *Miscanthus depauperatus,* were found near the crater of Mt. Canlaon.

Representatives of the dipterocarp family such as tangile *(Shorea polysperma),* white lauan *(Shorea contorta),* bagtikan *(Parashorea malaanonan)* form the canopy of the lowland evergreen forest. The common species forming the co-dominant layer of the canopy is kupang *(Parkia roxburghii).* The dense undergrowth is covered by ferns such as *Oleandra hurrei* and palms like *Pinanga sp.*

Giant trees such as the malakawayan *(Podocarpus rumphii)* grow at the mid-montane forest, while trees like bakawan gubat *(Carallia brachiata)* and bayanti *(Homolanthus sp.)* occupy the upper montane rainforest and are covered with lichens, mosses and epiphytic ferns.

F. Turtle Island Marine Natural Park (TIMNP)

Several plant species such as *Terminalia catappa, Cocos nucifera, Pandanus tectorius, Barringtonia asiatica, Erythrina indica, Caryota cumingii, Saccharum spontaneum, Calamusmollis sp., Ficus sp., Vitex trifolia, Livistona rotundifolia* and *Scaevola ceriacea,* from ten plant families are recorded in the TIMNP.

Several species of seagrasses were observed and one species, *Halophila ovalis,* was identified. Fifty seaweed species, 23 of which belong to Class Chlorophyta (green algae), four species to Class Phaeophyta (brown algae) and 23 species to Class Rhodophyta (red algae), were identified. The five most dominant species were *Galaxaura marginata, Halimeda velasquezii, H. tuna, Chlorodesmis comosa* and *Padina australis.*

Two endangered species of marine turtles nest in the islands: the green sea turtle *(Chelonia mydas)* and hawksbill turtle *(Eretmochelys imbricata).* Another reptile found in the area, the monitor lizard *(Varanus salvator),* is a natural predator of marine turtle eggs and hatchlings. Another species of lizard *(Mabuya sp.)* was also identified aside from two species of house lizards *(Gecko gekko and Gehyra sp.).*

Twelve species of birds were identified: two species, *Aplonis p. panayensis* and *Treron v. vernans,* are endemic throughout the Philippine Archipelago while one species, *Nectarinia jugularis woodi,* is endemic in Cagayan de Sulu. Other species of birds commonly observed were the *Egretta s. sacra, Ducula p. pickeringii, Sterna fuscata nubilosa, Haliaetus leucogaster* and *Pachycephala cinerea homereyi.*

The only mammals observed were rats, *Rattus tanezumi,* fruit bats and insectivorus bats, aside from the introduced species like cattle, goats, dogs, and cats.

The marine ecosystem contains coral reefs with a relatively fair coverage of 25-50 percent and exhibiting a high diversity level of 24 to 27 genera.

The fish assemblages were dominated mainly by the families Pomacentridae and Labridae. The common species found were *Pomacentrus moluccensis, P. vaiuli* and *P. alexanderae and Thalassoma lunare.*

G. Mt. Kitanglad Natural Park (MKNP)

Forty-two plant species are recorded at Mt. Kitanglad. Among these are a number of endemic plant species which are now considered rare.

Seventy-four avian species are recorded, including some species which were common during previous studies but are rarely observed at present such as *Phapitreron a. amethystina, Macrophygia phasianella tenuirostris, Prioniturus discurus, Trichoglossus jhonstoniae, Harpactes ardens, Coracina mcgregori, Aceros leucocephalus, Buceros hydrocorax mindanensis,* and *Basilornis miranda.* Some species, however, appeared more abundant compared to earlier observations. These include species like *Lophozosterops goodfellowi, Hypocryptadius cinnamomeus, Leonardina woodi* and *Erythrura coloria.* Another species, *Serinus estherae* was recorded for the first time. An important component of the avian fauna of Mt. Kitanglad Natural Park is the endangered Philippine eagle, *Pithecophaga jefferyi.*

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Very few mammalian and herpetological species were observed but this could be an artifact rather than a reflection of the real conditions in the area. Species belonging to the Families *Suidae* and *Cervidae* which used to be common in the area are now rare. This can be attributed to the increased demand for meat by the local inhabitants.

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H. Agusan Marsh Wildlife Sanctuary (AMWS)

In the Agusan Marsh, 28 species of flowering plants and three species of ferns were found (Davies, 1993).

A total of 102 bird species were identified. An endemic species recorded was the oriental darter, *Anhinga melanogaster,* which is very rare in the Philippines. Another was the purple heron, *Ardea purpurea,* which probably breeds in the area as

Lory Tan

evidenced by the numerous juveniles observed. There is a high diversity of the Family Columbidae and a high population level of waterbirds, especially the wandering whistling duck, *Dendrocygna arcuata.* These indicate that Agusan Marsh is a very important center of bird diversity.

Only ten freshwater fish species, among which are *Poecilia reticulata, Cyprinus carpio, Puntius sp., Channa striata, Clarias batrachus* and *Anabas testudineus,* were identified.

Two crocodile species, *Crocodylus porosus* and *C. mindorensis* were found in the vast herbaceous swamp and edges of the swamp forest. The predominant species is the *Crocodylus porosus*.

Seven species of snakes including the reticulated python, *Python reticulatus* and the Philippine cobra, *Naja naja*, are recorded.

Mammalian species such as pteropodid bats, squirrels, viverrids, wild pigs, rats, and macaques, *Macaca fascicularis*, are also reported.

Sixty-five species of butterflies, including three relatively rare species, *Papilio antonio, Graphium cordus* and *G. idaeoides*, were collected.

I. Siargao Island Wildlife Sanctuary (SIWS)

The SIWS includes three major types of ecosystems: 1) terrestrial, 2) wetland, and 3) marine, all exhibiting wide biological diversity.

Two species of *Rhizophora* are dominant in the mangrove forest. So far, only ten endemic species of flowering plants have been recorded, including the Philippine iron wood, *Xanthostermum verdugonianus*.

Several areas of thick beds of seagrasses and seaweeds were found. There are 59 species of seaweeds, comprising 37 percent of the total number of benthic seaweeds recorded from the Philippines. Also, eight species of seagrasses are found in the area, which is half of all the species found in the Philippines and the ASEAN region.

The fauna include several species of wetland birds, 11 species of terrestrial mammals, nine species of reptiles, three species of amphibians and 105 species of butterflies.

In the marine and wetland areas, 137 species of mollusks, 38 genera of corals and 106 species of fishes were recorded from a single reef.

Several endangered and rare species including *Crocodylus porosus* are found in the extensive mangrove areas and waters surrounding the island. The green turtle *(Chelonia mydas)* and the hawksbill turtle *(Eretmochelys imbricata)*, dugongs *(Dugong dugon)* and whale sharks, *(Rhincodon typus)* are also present in the area.

J. Mt. Apo Natural Park (MANP)

The flora include 629 species under 148 families of vascular and non-vascular plants. Five hundred seventy two species belong to 124 families of ferns and angiosperms, while 57 species belong to 24 families of bryophytes or mosses.

Among the vascular plants in the area, Moraceae, represented by the *genus Ficus*, has the highest number of known species. This particular group of plants is very important to the economy of the forest for they provide food to many species of birds and mammals. Most fruit-eating birds feed on *Ficus* fruits, particularly on the species bearing small reddish fruits which are quite abundant during summer.

*Ficus* and other small trees such as *Leucosyke, Nauclea, Macaranga, Homolanthus*, and *Dillenia* thrive in secondary forests at elevation of 300-500 m.a.s.l. such as in the Baratacab and Sibulan areas. Dipterocarp species like *Dipterocarpus, Shorea* and *Pentacme* dominate the vegetation at elevations of 650-1,000 m.a.s.l. such as in Tibulo and Todaya. However, the dipterocarps assume shorter heights and become co-dominant with other smaller trees and shrubs such as *Lithocarpus, Laportea*, and *Areca* at higher elevations of 1,400 -1,600 m.a.s.l. such as in Mainit-Kulan. At 1,800-2,000 m.a.s.l., particularly at Meran Baclayan, *Agathis, Lithocarpus, Cinnamomum* and gymnosperms are the dominant species. At the crater lake in Cirribal, *Rhododendron, Vaccinium, Gleichenia* and *Polypodiaceae* species were found to be most abundant along with bryophytes. Ferns and orchids are common as herbaceous component and as epiphytes.

Among the high value species of trees in the area are the almaciga or *Agathis philippinensis* and the dipterocarp species *Shorea polita* and *Vatica mangachapoi*. These tree species are threatened due to overlogging. The world famous *Vanda sanderiana* or waling-waling and the rattan species *Plectocomia elmiri* used to abound in the primary forests of Mt. Apo. However, these species can no longer be found in their natural habitats because of over collection.

Six endemic plant species are restricted to Mt. Apo. These were identified under the families (1) *Lauraceae (Alseodaphne philippinensis)*; (2) *Urticaceae (Cypholophus microphyllus)* at an altitude of 1,800 m.a.s.l.; (3) *Fagaceae (Lithocarpus*

*submonticulus)* at 1,700 m.a.s.l.; (4) *Nepenthaceae (Nepenthes copelandii)* in thickets at 2,400 m.a.s.l. and (5) *Piperaceae (Piperomia elmeri* and *P. apoanum)* at 800-1,200 m.a.s.l.

A total of 227 vertebrates species belonging to 69 families of amphibians, reptiles birds and mammals have been recorded in Mt. Apo. Likewise, 118 species of butterflies belonging to 69 families are recorded in the area.

Of the birds reported, most species are widely distributed and can be found throughout the Philippines such as the blue shortwing, *Brachypteryx montana*. The Philippine eagle, *Pithecophaga jefferyi*, the Philippine trogon, *Harpactes ardens*, and the yellow-bellied whistler, *Pachycephala philippinensis*, are species recorded in Luzon, Samar, Leyte, and Eastern Mindanao. The fly-catchers, *Eumyias panayensis*, and *Ficedula westermanni* are reported in Luzon, Mindoro, Negros, Panay, and Mindanao. *F. westermanni* can also be found in Palawan. The strong-billed shrike, *Lanius validirostis*, can be observed in the highlands of Mindoro, Luzon, and Mindanao, while the Philippine bullfinch, *Pyrrhula leucogenys*, occurs in the highlands of Luzon and Mindanao only. The presence of *L. woodi, R. goodfellowi, E. payanensis, F. hyperythra, R. nigrocinnamomea,* and *H. cinnamomeus* were also noted in the primary forest area.


Lory Tan

The Mt. Apo myna *Basilornis miranda*, the Apo lorikeet *Tricoglossus johnstoniae*, the cinnamon bird *Hypocryptadus cinnamoneus*, and the bagobo babbler, *Leonardina woodi*, and the black and cinnamon fantail are among the Mindanao endemics in MANP. These species are believed to have evolved on Mt. Apo before spreading to surrounding peaks such as in Katanglad, Malindang, and Matutum.

The Philippine eagle, *P. jefferyi*, is by far the most important bird species in Mt. Apo. This bird is not found elsewhere in the world and has become the symbol of Philippine conservation efforts. Widespread destruction of its habitat and over collection is driving this species to extinction.

Mammalian species include shrews and gymnures, bats, rats, squirrels, ungulates, civet cats, and deers. The families Pteropidae and Muridae are the most represented. The pteropid bats are common in Mt. Apo, particularly *Cynopterus brachyotis, Haplonycteris fischeri* and *Rousettus amplexicaudatus*. Of the mammals identified, only four are Mindanao endemics. These are *Apomys insignis, Urogale everetti, Sundasciurus philippinensis* and *Podogymnura truei*. The Philippine gymnure, *P. truei*, which belongs to family Erinacidae, was believed as restricted to Mt. Apo until it was collected in Mt. Kitanglad. The deer species, *Cervus mariannus apoensis* is the most threatened mammal in the area.

With regard to reptiles and amphibian species, they are either widely distributed in the Visayan and Mindanao Regions or occur throughout the country. Among the reptiles is the tree skink, *Lipinia quadrivitata*, which is also found in Borneo. As for amphibians, the pelobatid species *Megophrys hasselti* and *M. stejnegeri* are not only found in the Indo-malayan Region, but they also have considerable altitudinal ranges. They can be found from almost sea level to an elevation of 2000 meters. Important reptile species occurring in Mt. Apo include the burrowing skinks of the genus *Brachymeles* and the Cuming's eared skink, *Otosaurus cumingi*. The latter is rare and the largest in its family. The monitor lizard, *Varanus salvator*, is one of the species used as food.

Important amphibian species include the Philippine woodland frog, *Rana magna*, the broad hearted forest frog, *Leptobrachium hasselti*, the horned forest frog, *Megophrys monticola*, the

Mueller's toad, *Ansonia muelleri*, the Mindanao toad, *Pelophryne brevipes*, the montane narrow-mouthed frog, *Oreophryne annulatus*. *R. magna* is considered an endangered species throughout the country, because it is widely collected for food. Moreover, the rate of population increase of the species is slow for it requires unpolluted cool water for successful breeding. It also has a relatively long tadpole stage making it vulnerable to changes in the forest environment. *L. hasselti* is considered a true forest frog, because it cannot survive in open areas. This species is considered rare because of its cryptic, or secretive behavior, similar to *M. monticola*.

The butterflies in the area are numerous in terms of number of species. They occur in a wide range of habitat, from cultivated lands to grasslands, from second growth to primary forest. Among the species commonly found are *Eurema hecabe*, *Graphium sarpedon*, *Papilio rumnzovia*, *P. aquamemnon* and *Mycalesis tagala sermirasa*. Five endemic species of butterflies are known. These are: (1) *Parantica schoenigi*, (2) *Delias lecicki*, (3) *D. schoenigi*, (4) *D. apoensis*, and (5) *D. woodi*. Of the five, *D. woodi* and *D. schoenigi* have wider vertical distribution range. They were observed between approximately 800 and 2,400 m.a.s.l. All species are usually found close to bodies of water.

### 2.5.3 Rates of Change

The rates of change in the composition of the PAs national parks system was significantly minimal prior to the passage of the NIPAS Act in 1992. The absence of criteria on site selection and review resulted in the exclusion of some areas that were more biologically significant. The lack of concern in developing them also contributed in the addition of

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only few sites to the old system between 1977 and 1992.

As the number of national parks under the administration of DENR increased to 63 from 1931 to 1992, the rate of destruction and habitat conversion also increased. In 1991, the IPAS estimated, based on field reports, that about 50% of the 63 national parks were no longer biologically important and could be excluded from the new system developed under RA 7586.

Considering the nature of the destruction that continues to hammer the system, the wealth of biodiversity in the areas has been severely affected including those that comprise the remaining 50% of less marginalized national parks. The other types of reserves also share this fate.

The passage of the NIPAS law in 1992 expanded the number of Protected Areas from 69 National Parks, eight Game Refuges and Bird Sanctuaries and 16 Wilderness Areas to approximately 290 Protected Areas plus about 1,178,000 hectares of non-contiguous old growth forest.

All these areas must be reviewed to determine those that must remain under the new system. It is likely, based on current trends that the number of sites will increase. The provision of the law for addition of new areas that are rich in biodiversity resources further strengthens this trend. There are now nine coastal protected areas sites that have been added to the system.

The increase in the collective size (area) of the protected areas under the new system means an increase in biodiversity rich areas that the nation will be managing.

### 2.5.4 Biodiversity Values/Services

The *Batanes Protected Landscapes and Seascapes* are important flyways for migratory birds which roost all over the islands. This was one of the most important reasons why the entire province was recommended as a protected area.

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The *Northern Sierra Madre Natural Park* encompasses the largest block of species-rich primary lowland evergreen rainforest representing 25 percent of the remaining primary lowland evergreen rainforest cover in the Philippines. Its extraordinary high bird diversity has led international scientists to rate the NSMNP as among the most important areas for the conservation of bird diversity. The rich marine resources of the *area* offer wide opportunities for sustainable livelihood projects.

The *Subic-Bataan Natural Park* is the home of the Aetas. The parks are the site of the remaining vestiges of virgin forests in the Zambales Biogeographic Zone (ZBZ) which harbor some species not found elsewhere, e.g., mountain rose, fire orchid, oak, etc. The area is also endowed with mineral deposits.

The *Apo Reef Marine Natural Park* is the largest atoll formed reef in the Philippines. It exhibits a variety of habitats and has one of the richest concentrations of marine organisms. It serves as rookeries and homing grounds for migratory and resident species of birds, specially the globally endangered Nicobar pigeon. It is also a rich fishing ground that supplies the protein needs of the coastal communities of Mindoro.

*Mt. Canlaon Natural Park* is the only natural park in the Negros-Panay faunal region. An active strata volcano, Mt. Canlaon harbors sizable remnants of fast disappearing species of lowland evergreen rainforest.

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The *Turtle Island Marine Natural Park* contains the major nesting sites of the globally endangered green sea turtle or pawikan. Declaring it a conservation area will protect the pawikan from extinction. The very high biodiversity in the area will likewise be conserved including its outstanding geologic features, the mud volcanoes of Lihiman and Langaan Islands.

*Mt. Kitanglad* harbors three important habitat types, viz. lowland evergreen rainforest, mid-montane forest, and upper montane forest. It is home to a variety of endemic, rare, and endangered species that includes the Philippine eagle. The Park is a primary watershed and plays a vital role in regulating the supply of potable water and irrigation water to Bukidnon and other provinces of Mindanao.

The *Agusan Marsh*, the flood plain of the Agusan River, is the catch basin of the Agusan-Davao area in eastern Mindanao. It is the area of confluence of the different tributaries of the Agusan River which drains the Diwata Mountain Ranges of Surigao del Norte and Surigao del Sur in the south. It also holds the largest expanse of swamp forest not found anywhere else in the Philippines. The wildlife sanctuary is said to be the wintering ground for hordes of migratory waders. The marsh also serves

Lory Tan

as a flood control system protecting many neighboring municipalities from getting inundated during the wet season.

*Siargao Island's* coral reef complex is quite pristine and harbors a rich population of uncommon violet lace coral and pink lace coral. The vast mangrove forest protects the island against the impact of typhoons and winds during inclement weather. The sanctuary provides much of the food needs of the people of Siargao.

Lory Tan

*Mt. Apo* is the Philippines' highest peak characterized by very diverse habitat types, including important forest types, sulfuric hot springs, and mountain lakes. It is the home of the endangered Philippine eagle. It also serves as the major watershed of the city of Davao and the adjoining provinces and municipalities.

# 3.0 CONSERVATION MEASURES AND STRATEGIES

## 3.1 Problems and Threats to Biodiversity

### 3.1.1 General

#### Human Population Threats

The carrying capacity of the earth is not a natural constant but rather a dynamic equilibrium that is essentially determined by human activities. There are two major types of carrying capacity: the productive carrying capacity—the ability to provide resources such as food and minerals; and the waste carrying capacity—the ability to absorb a certain level of pollution or degradation without significant damage. The dynamic nature of carrying capacity indicates that it adjusts to the increasing demands imposed on it. There are already some indications in certain parts of the country that limits are only an arm's length away. Renewable resources are already showing signs of stress due mainly to increasing demands from a rapidly expanding human population. The number of Filipinos grew 2.4% annually during the last two census years 1980 and 1990. On the other hand, the gross value added (in real terms) in agriculture, fishery, and forestry have increased (decreased) annually by 1.6%, 2.4%, and (6.2%) in almost the same period, 1981 and 1990. More recently, the changes in sectoral output were 2.2%, 2.0% and (21.82%) in 1990 to 1993, respectively (refer to Table 24). Clearly, per capita consumption of biological resources is declining. To keep up with the growing demand brought about by increasing population and, more recently, household incomes of certain sectors, production intensification is in order. In instances where production of renewable resources, e.g., forests and fisheries, have exceeded rates of renewal, stress on such resources ensue. The pressures of human need and their rising expectations for fuel, food, housing, land, minerals, industrial products and leisure conspire in disrupting the ecosystems and reducing wild populations of animals and plants on an unprecedented scale.

Poverty and the inequitable distribution of wealth exacerbate the impacts of human population on living resources and biodiversity. About 40% of Filipino families live below the poverty line which means that over 29 million individuals lack the means to meet their basic needs for physical survival much more lead meaningful lives. This condition has a built-in tendency for more intensive extractive activities as shown by the preponderance of extractive types of occupation. All these conditions present opportunities for biological and environmental degradation. Previous economic upturns have failed to improve significantly the plight of the poor thus sustaining the sharp contrast in income levels and access to income opportunities. This is corroborated by the data on the low level of labor participation rate in the rural areas.

## Land Use Threats

Land uses that pose threats to biodiversity include infrastructure development, both existing and proposed, such as the major industries, road networks, irrigation, water resources, power and energy projects, ports and harbors, and others. Infrastructure affect biodiversity directly and indirectly. Directly, their operations and possible expansion may disturb, pollute, or encroach upon biodiversity-rich ecosystems. Indirectly, they may attract satellite development of settlements that can cause fragmentation of species-rich habitat. Roads provide easy access to biodiversity rich ecosystems like old growth forests. Industries threaten the quality of surrounding water bodies that support a variety of aquatic resources including endemic species of plants and animals. In most instances, industrial wastewater treatment plants and air pollution control devices are absent or minimal.

The level of threat posed by a particular infrastructure on a biodiversity-rich area is determined in terms of its spatial relationship with the latter. A more accurate method of determining threat involves the delineation of influence areas or impact zones by use of: (1) drainage patterns and downstream impact areas to plot water pollution impact areas, (2) airshed and meteorological behavior to plot air pollutant impact areas, and (3) nearest settlements and access roads location to plot settlement impact areas.

Threatened diversity rich areas can be depicted by mapping. A radius of less than five kilometers from a biodiversity rich area is considered high threat or highly probable; 5 to 20 kilometers – moderate; and more than 20 kilometers low. Using this approach, the results of the assessment show that existing infrastructure highly threaten an estimated total area of about 1.6 million hectares of biodiversity-rich ecosystems. Biogeographic zones registering large areas under high threat include North/South Luzon (476,248 ha), Mindanao (319,484 ha), Palawan (192,084 ha), Sierra Madre (160,282 ha), Eastern Visayas (145,114 ha), and Cordillera (107,119 ha). Potential threats from planned infrastructure using the same procedure are reflected on the map. This information can serve as a guide in the conduct of more detailed studies on the mapping of threats from infrastructure development.


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The classification used in mapping biodiversity-threatened areas depicts in a symbolic form the type of ecosystem threatened, the nature of the threat, whether immediate or potential, and the level or degree of the threat.

In absolute figures, dipterocarp forests have the biggest threatened area in the extent of 2.2 million hectares followed by coral reefs with 345,762 hectares, mossy forests with 230,428 hectares, and mangrove forests with 143,307 hectares (Table 74 and Figure 16). However, in relation to the percentage of their total area, mangrove forest has the biggest threat posed by existing infrastructure. About 56 percent of its total area is threatened by different types of infrastructure. It is followed by coral reefs (39 percent), mossy forests (27 percent), and dipterocarp forests (14 percent). In terms of biogeographic zones, Palawan has the biggest area of highly threatened ecosystems with 25 percent of its total area followed by North/South Luzon with 22 percent, and Mindanao with 19 percent (Map 6).


***Table 74*** *Highly threatened biodiversity-rich ecosystems due to existing infrastructure*

| ECOSYSTEM TYPE | TOTAL AREA (ha.) | HIGH THREAT (ha) | PERCENTAGE |
|---|---|---|---|
| Dipterocarp Forest | 2,235,604 | 321,437 | 14 |
| Mossy Forest | 230,428 | 39,306 | 17 |
| Mangrove Forest | 143,307 | 80,344 | 56 |
| Coral Reef | 345,762 | 134,230 | 39 |

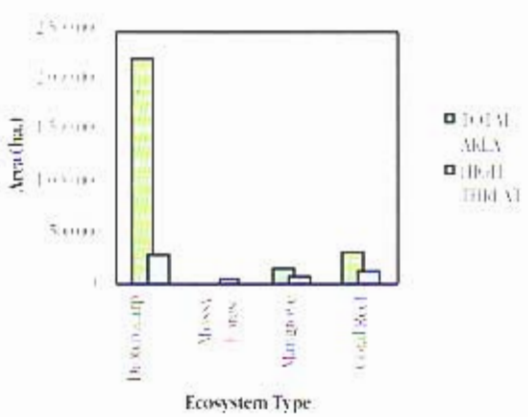


**Figure 16** Highly threatened biodiversity-rich ecosystems due to existing infrastructure

Table 75 and Figure 17 shows the extent of biodiversity-rich ecosystems which are highly threatened by the different types of existing infrastructure. Eighty-three percent of the total area of biodiversity-rich ecosystems is threatened by the presence of roads; 12 percent by ports and harbors; four percent by power and energy projects; 0.4 percent by industrial growth areas. Table 76 lists the top biogeographic zones which receive the biggest threat from the various existing infrastructure.

The threat posed by proposed or planned infrastructure development including the establishment of regional agro-industrial centers was also examined using the afore-cited method. Results of the assessment yield a much smaller area of highly threatened biodiversity compared to that of existing infrastructure. The reason could be an incomplete reporting of proposed projects by some regions. It could also mean that infrastructure planning undertaken by concerned agencies took

***Table 75*** *Extent of biodiversity-rich ecosystems threatened by different types of existing infrastructure*

| EXISTING INFRASTRUCTURE | HIGH THREAT (in hectares) | PERCENTAGE OF TOTAL |
|---|---|---|
| Road | 545,844 | 83.3 |
| Power and Energy | 27,451 | 4.2 |
| Ports and Harbors | 79,255 | 12.1 |
| Growth Areas | 2,586 | 0.4 |
| TOTAL AREA | 655,116 | 100.0 |

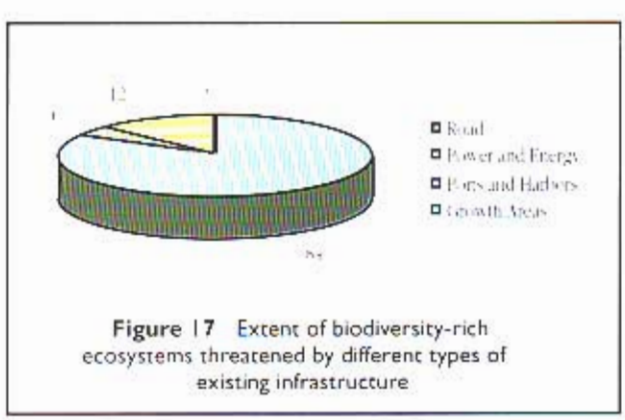


**Figure 17** Extent of biodiversity-rich ecosystems threatened by different types of existing infrastructure

***Table 76*** *Biogeographic zones receiving highest threats from various infrastructure projects*

| INFRASTRUCTURE TYPE | BIOGEOGRAPHIC ZONE | AREA (ha) | PERCENT |
|---|---|---|---|
| Road | Palawan | 157,885 | 29 |
| | N/S Luzon | 116,525 | 21 |
| | Mindanao | 102,871 | 19 |
| Power and Energy | Sierra Madre | 11,570 | 38 |
| | Mindanao | 10,468 | 39 |
| Ports and Harbors | Sierra Madre | 23,124 | 29 |
| | Eastern Visayas | 22,109 | 28 |
| | Mindanao | 15,495 | 19 |
| Growth Areas | Eastern Visayas | 2,294 | 89 |

into account biodiversity conservation. Preparation of the Regional Physical Framework Plans spearheaded by the NEDA, for instance, has avoided the siting of infrastructure development in biodiversity-rich areas. This kind of planning advances the value of biodiversity conservation. Most likely, the two reasons above cited are valid but their degree of validity cannot simply be ascertained.

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An estimated total area of about 54,000 hectares is highly threatened by the proposed/planned infrastructure development nationwide. Eastern Visayas has the largest area (34,579 ha) followed by North/South Luzon (6,890 ha), and Central Visayas (4,768 ha) BZ. A gratifying note is that, based on available data from NEDA, high level of threat from planned major infrastructure development is absent in biodiversity rich Cordillera, Zambales, Calamian, Palawan, and Liguasan biogeographic zones (Table 77).

Coral reefs represent a biodiversity-rich ecosystem highly exposed to threats of planned or proposed infrastructure. About 13,459 hectares of coral reefs are subject to this threat. This is followed by mangrove forests with 5,404 hectares, and dipterocarp forests with 3,219 hectares (Table 78). In relation to the percentage of their total area exposed to threat from proposed infrastructure development, coral reefs, together with mangroves, again top the list with four percent followed by dipterocarp forests with 0.14 percent.

Proposed agro-industrial centers present the biggest threat to about 45 percent of biodiversity-rich ecosystems compared to other proposed infrastructure. Ports and harbors pose 27 percent high threats; power and energy projects, 18 percent, and industries, 10 percent (Table 79 and Figure 18).

### 3.1.2 Forest Ecosystem

*Plant Domestication.* The process of harvesting wild plants, propagating them in cleared plots, and selecting favored varieties was a prevalent practice in prehistoric days before the advent of the colonial period. But this activity has declined thereafter because of the switch to plant species with trade potential. However, our forests still offer a wide range of utilized or under utilized resources for economic exploitation. This renewed interest and demand for exploitation and domestication of wild plants constitutes a threat to forest biodiversity as the rationale for forest preservation may diminish with the clamor for valued forest resources.

*Biotechnology.* Biotechnology is a tool to develop genetic resources through the manipulation of microorganisms, plants, and animal cells to produce food, medicine, chemicals, and other useful products through both classical and modern processes such as fermentation, tissue culture, enzyme technology and recombinant DNA (Balcita, 1995). Caution, however, must be applied in the introduction and utilization of biotechnology products. Some ill effects of biotechnology may include the loss of diversity such as excessive uniformity of plant and animal varieties and ecological imbalances with the introduction of new or modified life forms in the

***Table 77*** *Areas (in hectares) of biogeographic zones threatened due to infrastructure development*

| BIOGEOGRAPHIC ZONE | NATURE OF THREAT | | | | ZONE TOTALS |
|---|---|---|---|---|---|
| | IMMEDIATE* | | POTENTIAL** | | |
| | HIGH | MEDIUM | HIGH | MEDIUM | |
| N/S Luzon | 476,248 | 831,608 | 6,890 | 1,177 | 1,315,923 |
| Cordillera | 107,119 | 67,888 | | | 175,007 |
| Sierra Madre | 160,282 | 648,391 | 571 | 499 | 809,743 |
| Zambales | 14,135 | 25,048 | | | 39,183 |
| Mindoro | 13,453 | 69,012 | 416 | | 82,881 |
| Calamian | 25,393 | 20,681 | | | 46,074 |
| E. Visayas | 145,114 | 277,202 | 34,579 | 3,616 | 460,511 |
| W. Visayas | 56,826 | 126,543 | 660 | | 184,029 |
| Central Visayas | 9,937 | 5,662 | 4,768 | | 20,367 |
| Palawan | 192,084 | 371,580 | | | 563,664 |
| Mindanao | 319,484 | 1,546,451 | 3,070 | | 1,869,005 |
| Zamboanga | 67,272 | 340,911 | 2,247 | 2,975 | 413,405 |
| Liguasan | 53,462 | 80,800 | | | 134,262 |
| Sulu | 5,503 | 15,248 | 676 | | 21,427 |
| Grand Total (In Hectares) | 1,646,312 | 4,427,025 | 53,877 | 8,267 | 6,135,481 |

**Immediate threat caused by existing infrastructure*
***Potential threat caused by proposed infrastructure*

***Table 78*** *Highly threatened biodiversity-rich ecosystems due to proposed infrastructure projects*

| ECOSYSTEM TYPE | TOTAL AREA (ha) | HIGH THREAT (ha) | PERCENT |
|---|---|---|---|
| Dipterocarp forest | 2,235,604 | 3,219 | 0.14 |
| Mossy forest | 230,428 | 0 | 0 |
| Mangrove forest | 143,307 | 5,404 | 3.77 |
| Coral reef | 345,762 | 13,459 | 3.89 |
| **TOTAL** | **2,955,101** | **22,082** | **0.75** |

***Table 79*** *Extent of threat posed to biodiversity-rich ecosystems by different types of proposed infrastructure*

| PROPOSED INFRASTRUCTURE | HIGH THREAT (in hectares) | PERCENT OF TOTAL |
|---|---|---|
| Industries | 2,251 | 10 |
| Power and energy | 3,849 | 18 |
| Ports and harbors | 5,900 | 27 |
| Growth areas | 9,622 | 45 |
| **TOTAL AREA** | **21,622** | **100** |

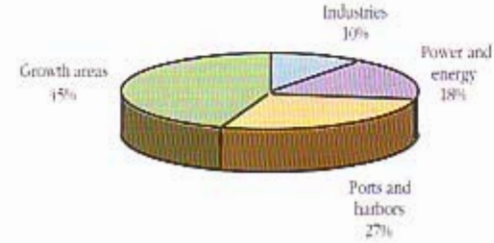


**Figure 18** Extent of threat to biodiversity-rich ecosystems posed by proposed infrastructure

ecosystem. Another area of concern is in assuring continuous supply of diverse germplasm in the wild to meet the demand of biotechnology. At the rate that forests are being depleted and the genetic resources therein disappearing, even with vigorous researches, the prospects for achieving maximum results through biotechnology do not appear to be too promising.

*Plant Introduction.* Several plant species were introduced to the Philippines during prehistoric times, most of these from neighboring Asian countries. With the coming of the Spaniards, many plants were introduced from the Americas. Today, many of these plants are cultivated as plantation crops, ornamentals, and timber trees. Agroforestry systems and reforestation projects in the Philippines intensively make use of exotic species. In recent years, exotic species monoculture has been plagued with pests and diseases. Exotic ornamental plants, largely orchids, have been introduced into the country and many are used as parental stocks for orchid breeding. One threat is genetic dilution of native and endemic orchid species as well as the introduction of pathogens that could cause large scale epidemics.

*Ecotourism.* Ecotourism involves travelling to relatively undisturbed or uncontaminated natural areas with the specific objective of studying, admiring, and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations (Ceballos-Lascurain cited in Boo, 1990). The industry is designed to promote environmental education and protection, as well as economic development wherein benefits accrue to the concerned community. However, with the influx of tourists and stimulated economic activity, the tourism industry contributes to environmental degradation. Disturbance of the ecology is inevitable in ill-managed sites with concommitant pollution, soil erosion and other ill effects.

*Habitat Degradation.* The decline in the quality and quantity of the country's forest biodiversity is largely due to the degradation of the forests, e.g., through forest fires, logging, kaingin, and pests and diseases (Table 80 and Figure 19). Generally, except for 1988 and 1989, forest fire has been the major cause of forest destruction. Logging, kaingin or slash and burn agriculture and to a small extent, pests and diseases, are secondary causes.

*Forest fires.* Natural forest fires are common in dry montane forests, pine forests, and forests interspersed with grassland. They occur quite rarely in deciduous forests. Fires commonly occur during the dry season when the forest litter easily ignite spontaneously with high temperature. With the El Niño phenomenon recurring almost annually, many

***Table 80*** *Forest destruction by cause, 1981-1993 (in hectares)*

| | TOTAL | | KAINGIN | | FOREST FIRE | | ILLEGAL LOGGING | | PESTS AND DISEASES | | OTHERS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | PERCENTAGE | AREA | PERCENTAGE | AREA | PERCENTAGE | AREA | PERCENTAGE | AREA | PERCENTAGE | AREA | PERCENTAGE | AREA |
| 1981 | 100.00 | 24,654 | 50.68 | 5,826 | 23.68 | 12,471 | 24.82 | 6,108 | 0.81 | 200 | | - |
| 1982 | 100.00 | 16,706 | 48.41 | 3,286 | 19.75 | 8,065 | 29.75 | 4,954 | 2.11 | 351 | | - |
| 1983 | 100.00 | 121,329 | 97.22 | 2,241 | 1.85 | 117,951 | 0.84 | 1,015 | 0.10 | 119 | | - |
| 1984 | 100.00 | 4,930 | 64.80 | 1,137 | 23.23 | 3,177 | 9.77 | 478 | 0.12 | 6 | 1.98 | 97 |
| 1985 | 100.00 | 14,652 | 80.26 | 941 | 0.45 | 11,743 | 13.11 | 1,918 | 0.21 | 30 | | - |
| 1986 | 100.00 | 7,727 | 55.42 | 1,991 | 25.92 | 4,257 | 1.17 | 90 | 17.50 | 1,344 | | - |
| 1987 | 100.00 | 7,171 | 75.37 | 570 | 7.98 | 5,386 | 9.46 | 676 | 0.03 | 2 | 7.16 | 512 |
| 1988 | 100.00 | 10,551 | 4.12 | 2,934 | 28.42 | 423 | 13.63 | 4,174 | | - | 23.83 | 2,444 |
| 1989 | 100.00 | 12,909 | 5.27 | 4,083 | 36.55 | 675 | 13.48 | 1,727 | 1.70 | 218 | 43.01 | 5,511 |
| 1990a | | 15,519 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1991 | 100.00 | 7,252 | 81.18 | 759 | 10.49 | 5,872 | 1.00 | 72 | | - | 7.33 | 530 |
| 1992 | 100.00 | 12,807 | 99.33 | 86 | 0.67 | 12,720 | | - | | - | | - |
| 1993 | 100.00 | 17,876 | 85.82 | 90 | 0.50 | 15,330 | | - | | - | 13.67 | 2,442 |

*Source: Planning and Policy Service, DENR*

a. Disaggregation not available

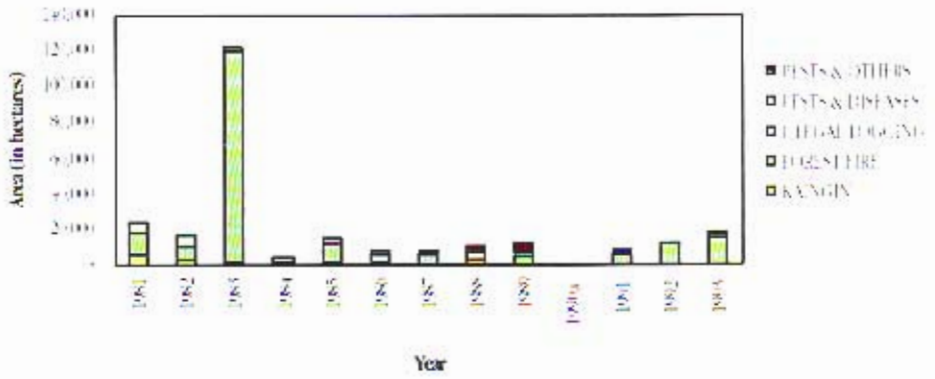


**Figure 19** Forest destruction by cause (1981 to1993)

of the burnt forest can not regenerate to their original state. The forests of Mt. Malindang, Mt. Kitanglad, and Mt. Apo, all in Mindanao Island, have been severely affected by forest fires.

*Logging.* This is a very serious threat to our forests. The demand for livelihood opportunities of the increasing upland and rural population and continued operations in forest concessions altogether deplete the forest cover to a considerably vast extent. This is the common scenario in many parts of the country today. Only a few areas like Palawan, Samar, and Agusan have some remaining virgin forests.

*Kaingin.* Kaingin activities practiced by uplanders and displaced logging workers also deplete and degrade forest habitats to a considerable extent. These people cut and burn stands of forests or burn logged forest remnants to grow cash crops such as rice, corn and vegetables. These plots are abandoned after a year or two when the soil is no longer fertile or suitable for agriculture. Because of nutrient depletion and lack of shade, the kaingin areas take many years before they can regenerate, if they regenerate at all.

*Pests and Diseases.* Forest plantations have decreased their production because of pests and diseases which plague the trees, e.g., gall disease of *Albizia falcataria*, varicose borer of *Eucalyptus deglupta*, plant lice or psyllids of *Leucaena leucocephala*, bark and shoot borers of *Pinus* species, and shoot borer of *Swietenia macrophylla*. For dipterocarps, some of the common fungi causing decay are *Fomes luzoniensis*, *F. semitostus*, *F. merrillii*, *F. applanatus*, *F. pachyphloeus*, *Polyporus semitostus*, *Pyropolyporus merrillii*, *Elvingia elmeri*, *E. fullageri*, and *Ganoderma elmeri*.

*Overexploitation.* Many forest species are of ornamental value and are much sought after by local and international traders. Among the highly prized ornamental plants are the jade vine *(Strongylodon macrobotrys)*, giant staghorn fern *(Platycerium grande)*, waling-waling *(Vanda sanderiana)*, and many tree fern species like *Cyathea spp.* and *Cibotium spp.* Tree fern trunks are used as substitute for driftwood and serve as attractive substrate for growing orchids. Thus, tree fern trunks are overcollected in response to the high demand of the orchid industry. Non-timber forest products like resin and rattans are over harvested, thus decreasing the natural population to very low levels. At present the population of almaciga *(Agathis philippinensis)* and rattans *(Calamus* and *Daemonorops)* are threatened.

Some of the animal species that are overcollected are the Palawan peacock pheasant *(Polyplectron emphanum)*, Philippine cockatoo *(Cacatua haematuropygia)*, talking mynah *(Gracula religiosa)*, blue-naped parrot *(Tanygnathus lucionensis)*, Asian small-clawed otter *(Amblonyx cinereus)* for the pet trade; mousedeer *(Tragulus napu)*, wild pigs *(Sus spp.)* for food; Palawan pangolin *(Manis javanica)* for stuffed specimens; Palawan tree shrews *(Tupaia palawenensis)* and squirrels *(Sundasciurus spp.)* for experimental animals; flying squirrels *(Hylopetes nigripes)* for sports; butterflies *(e.g. Papilio chikae, Graphium agamemnon* and *Papilio rumanzovia)* for hobby and export. Exploitation of some byproducts of wildlife species

also endanger their survival such as the nests produced by the edible-nest swiftlets *(Collocalia fuciphaga)*.

*Mining and Energy Projects*. Open pit mining, as practiced in Benguet and Marinduque, destroys vast tracts of forests. A significant amount of forest cover has also been lost to energy production. Several forest lands have been turned over to government agencies engaged in energy production such as geothermal sites (Tiwi, Albay; Tongonan, Leyte; Mt. Apo, Mindanao; Makban, Laguna; Mt. Labo, Camarines Norte/Sur); and coal-fired powerplants (e.g., Grande Island, Pagbilao, Quezon Province).

*Natural Calamities*. One of the most destructive natural phenomena that can cause extinction of many plant and animal species is volcanic eruption. Many of our centers of diversity are found in mountains of volcanic origin. When Mt. Pinatubo erupted in 1991 after 600 years of dormancy, some rare and endemic species are presumed to have been decimated (Madulid, 1992). It may probably take a hundred years or more before the original vegetation of Mt. Pinatubo flourishes again. Earthquakes which cause landslides erode soils and overlying vegetation in steep and sloping landscapes. Because of thinned or loose topsoil, it is difficult for vegetation to regenerate to their original state. This is observed in many cliffs and mountains sides of Benguet, and in many parts of the Cordilleras.

### 3.1.3 Wetland Ecosystem

Wetlands hold a significant parcel of the wealth that sustains the life and means of livelihood of more than one-half of the entire Philippine population. And yet wetlands continue to be the subject of abuse, over-use, and neglect. The most revealing assessment of the state of biodiversity in the country today was succinctly put during the latter part of the last decade which describes the Philippines as probably representing the single worst case scenario at present in terms of loss of biological diversity in tropical Southeast Asia in particular comparison with Malaysia, Indonesia, and Papua New Guinea (Sohmer, 1989).

The problems confronting the wetlands cannot be treated in isolation from those which affect the landscape. Wetlands receive their water from the terrestrial catchment areas. Coastal wetlands, on the other hand, are linked both physically and biologically with the sea. Water is exchanged between the two areas and migratory fish species complete their life cycle in both. The management of wetlands therefore is linked with the management of the terrestrial ecosystems and the marine environment.

A host of negative impacts impinge on wetlands such as overfishing, reclamation for various purposes, siltation from deforestation, cultural eutrophication, water-level lowering, and pollution or the discharge of toxic substances, the last three being the most common for Asian wetlands (Bjork, 1994).

In the Philippines, the general threats to wetlands stem from two realities: (a) the burgeoning population, and (b) the mindless exploitation of natural resources for selfish, short term gains. Major threats are siltation, over-exploitation, and cultural eutrophication. However, the gravity of these threats across wetland biological resources may differ as discussed below.

*Species Introduction*. Introduced species may take advantage of the resources not fully utilized by the native species and establish large populations which spread rapidly and invade other bodies of water. The absence of their natural enemies make control or eradication difficult. A good example is the recent introduction of the waterfern *Salvinia molesta*, a serious weed in many Asian countries which is now rapidly spreading in the Philippines. Another example is the golden apple snail, *Pomacea spp.*, which was introduced in the early 1980s and which has become one of the biggest threats to endemic species of freshwater gastropods like *Pila (Ampullaria) luzonica*. There is high probability that *P. luzonica* will totally be displaced by *Pomacea* and, thus, eventually become extinct. The golden apple snail is also now a national pest of rice, having successfully invaded and established itself in almost all irrigated ricefields in the country.

*Pollution*. Heavy metals like copper, mercury, and cadmium inhibit growth in most plants and cause negative sublethal effects on fauna, like fish. These elements maybe introduced in water bodies from factories and mine tailings. Some pollutants result in the eutrophication of water bodies and although some wetland resources thrive well under eutrophic conditions, certain pollutants are detrimental to their growth and development.

Some effects of pollution are the following: (1) low water quality due to decreased level of dissolved oxygen,decrease in pH, changed water temperature, and increased carbon dioxide concentrations. These


Lory Ian

may lower the ability of the water to absorb organic pollution and result in septic conditions. Accumulation of organic materials from various sources may also reduce the clarity of water; (2) lower fish production when large macrophytes like the water hyacinth *(Eichhornia crassipes)* cover the water surface and reduce the growth of phytoplankton that provide food to fish; (3) increased incidence of disease and pests in plants and animals when macrophytes provide more habitat for vectors; (4) decreased water flow in canals and streams that may result in flooding; (5) hampered water navigation when submerged macrophytes slow the action of boat's propellers, and floating macrophytes block the waterways; (6) large amount of water loss due to plant transpiration and decrease of water storage area due to plant inhabiting.

The impact of pollution of lakes, rivers, and streams on insects has hardly been studied, despite the fact that many insect groups, e.g., mayflies, caddisflies, stoneflies, dragonflies, damselflies, and bugs, can be used as indicators of either a healthy or highly polluted wetland. The use of pesticides in water bodies such as rice paddies and irrigation canals must be discouraged or reasonably reduced since these habitats harbor many beneficial aquatic insects vulnerable to insecticides, e.g., aquatic bugs above and beneath the water surface, several beetle families, and naiads of damselflies (often *Agriocnemis* and *Ischnura)*, dragonflies *(Diplacodes, Crocothemis, Orthetrum, Pantala)* and mayflies, and larvae of many saprophytic flies such as midges and crane-flies, which participate in the functioning of the complex food webs in the ecosystem.

*Deforestation/Siltation.* Loss of forest covers result in the siltation and ultimately death of small streams and habitat loss for macrophytes. It is a serious threat especially to certain endemic species like *Isoetes philippinensis* and *Cryptocoryne apogenitifolia* which are known to inhabit such wetland type. Siltation may reach larger bodies of water of which these streams are tributaries.

In many instances, the habitats of insects are in wetlands under forest cover, such as rivers and streams, or ponds and lakes. The problem of deforestation, which occurs at an increasingly rapid rate in watersheds and mountain slopes and gullies which harbor these habitats, is now acute for most parts of the country. The destruction of these habitats, which can be massive when compounded with kaingin activities, means the virtual extinction of small populations of many endemic insect species many of which have been recorded only in specific localities within a biogeographic zone.

*Infrastructure Development, Human Settlements Development, and Urbanization.* The construction of massive structures and subdivisions critically affect the course of ecological development that a water body will take in the short and long-term. Infrastructure development is a spawning ground for problems related to the multiple use of wetlands. The immediate effect though is habitat loss for algae, macrophytes, invertebrates, insects, fishes and other organisms.

*Overexploitation.* Exploitation of fish populations, as has happened in Laguna Lake in 1966-1967, presumably led to depletion of fish, resulting in the population explosion of midges (Chironomidae and Ceratopogonidae), probably an important food item of the fish. The phenomenon could also have been caused by other factors, such as pollution, excess organic matter deposits into the lake, algal bloom and the like. Since the research on the midge problem was terminated when the midge problem died down naturally, one cannot be certain of the actual causes of midge population outbreak. It is of value to pursue studies on the role of insects as food of fish and other commercially valuable aquatic resources.

### 3.1.4 Marine Ecosystem

Although there is a growing movement to understand, protect, and sustainably use the sea, there are significant obstacles to marine conservation. Some are scientific or technical. Some stem from our ignorance of the sea's value and vulnerability plus the fact that what is known is not available to those who need the information. Other

impediments are cultural (the replacement of diverse human cultures adapted to living sustainably in coastal ecosystems by a wasteful, consumer-oriented world culture), economic (the 'tragedy of the commons', intergenerational inequities, undervaluing of life in the sea), political (north/south friction, national sovereignty, fragmented decision making), and legal (gaps and overlaps in jurisdiction, placing the burden of proof on those who would conserve marine life). Peripheral problems impact on the marine sector. The substantial debt burden, which generates annual payments equal to 40 percent of the GNP, and the rapidly increasing population further exacerbate the problem.

A specific case is the problem encountered in the protection of the country's coral resources, the most prominent of which is overpopulation especially of those dependent upon the coral reef resources. There is also the inability of authorities to limit access to reefs. Moreover, there is the grave lack of knowledge on the distribution of coral reefs both in space and in time, and their controlling factors. In parallel, there are management problems in the protection of sea cows and sea turtles. Their conservation is difficult, because they breed very slowly; there is lack of data on population dynamics and habitat requirements; and there is the widespread habitat destruction and conflicts with humans like for instance, the eggs of sea turtles are savored as delicacies. Other reasons include few and ineffective information campaigns, lack of appreciation on the part of residents and officials of the value of dugongs and turtles, non- or insufficient implementation of pertinent laws, and lack of funds to undertake needed activities.

Five root causes underlie the threats to marine life: imbalance between overpopulation and dwindling natural resources; high consumption rate; institutions and culture encourage practices that degrade rather than conserve biodiversity; lack of needed knowledge; improper regard for the value of nature. Unless these underlying causes are effectively addressed, efforts to conserve the marine environment and its biodiversity can only delay the inevitable.

Of more direct consequences is that we harm marine biodiversity in a number of ways, some of which interact to worsen the situation: overexploitation of living resources of the sea; altering the physical environment; adding pollutants; introducing alien species; altering climate, and increasing ultraviolet radiation by adding substances to the atmosphere. The effects of overexploitation and pollution are far better known than those of the other threats. Most marine species that have been driven to extinction in modern times were victims of overexploitation and many fisheries are locked in boom-and-bust cycles (Norse, 1993).

On the bright side, however, local area management plans are helping to protect Philippine coastal resources. This is brought about by the realization of the need to take immediate positive steps in addressing the following issues which are causing widespread alteration in coastal habitats in the country: severe marine environmental degradation; heavy exploitation of coastal resources; lack of public appreciation of management efforts; lack of management capabilities; many people living in poverty; inadequate institutional support and poor law enforcement.

### Threats to Seagrass Beds and Soft Bottom Communities

The causes of seagrass and soft bottom habitat degradation and loss in the country are not different from those which generally afflict other coastal zones in Southeast Asia. Based on attempts to synthesize the issues confronting the development and management of the coastal zone in the region, the causal factors can be placed under three categories: biophysical issues; sociocultural issues, and institutional issues (Fortes & McManus, 1994). This categorization, however, is artificial as these issues are interconnected and interdependent. If they are separated in this report, it is only for convenience in presentation to facilitate ease in understanding them. They have been the focus of numerous conferences in many parts of the world so that only those aspects which directly relate to seagrass and soft bottom ecosystems will be emphasized.

The biophysical issues confronting coastal zone management in the Philippines include: degradation of coastal ecosystems and habitats; declining water quality and pollution; declining coastal fisheries; endangered marine species and coastal wildlife; coastal hazards including ocean storms and flooding; and global sea level rise. Present sea temperatures in the East Asian seas are expected to increase by 1.0°C (Chou, 1994), with resulting enhanced evaporation and increased precipitation that will likewise be expected to affect water salinity. With increased precipitation, more nutrients will be washed out to sea which can either have positive or negative effects for seagrass communities

depending on the actual load. With erosion, enhanced current patterns in nearshore areas where seagrasses abound will be altered bringing about adverse effects on the breeding and nursery functions of the coastal ecosystems.

A rise of sea level within the predicted range of 20 cm by 2025 is likely to be insignificant compared with man-induced influences on the coastal environment. Nevertheless, there would be substantial negative impacts on the seagrass community. They would be subjected to increased frequency and severity of storms and wave surge, increased rates of shoreline erosion, wetlands inundation and recession, modification of dynamic coastal physical properties, and damage to, or reduction of shoreline protective structures and facilities (Davidson & Kana, 1988). The position of soft bottom communities relative to tidal levels makes them unaffected by sea level rise. It would be different for photosynthesizing benthos, however, if the water that rises is poor in quality as to block the effective photosynthetic active radiation for primary productivity.

The sociocultural issues in coastal zone management in Southeast Asia include: poverty, population growth, degradation and loss of scenic values and cultural resources, loss of access to commonly held natural resources, public health problems, increasing social conflicts, and certain misconceptions that guide man's actions.

The institutional issues include: low institutional capability for coastal area management, overlapping jurisdictions/interagency conflict, lack of mechanism to limit free access to fishery resources, lack of national policy on strategic development of the coastal zone, inadequate public support for management initiatives, inadequate implementation of existing regulations, and lack of an alternative paradigm of economic development that is both ecologically sustainable and politically acceptable.

### Threats to Coral Reefs

Reefs are in decline throughout the Philippine archipelago due to blast and cyanide fishing, muro ami fishing, sedimentation, port construction and eutrophication (Jameson et al. 1995). Coral cover is rapidly declining and fish populations are low from overfishing. The loss of 80 percent of the mangroves and more than half of the total forest area since 1920 has stressed reefs with sedimentation and caused fish populations to decline. Large areas of the Scarborough reef off Luzon and other large offshore reefs have been denuded of fish and coral from blast and muro ami fishing within the last two years. Between 1966 and 1986 the productivity of coral reefs in the Philippines dropped by one-third as the national population doubled. The Philippines is the major exporter of coral for displays and for aquariums, despite being prohibited within the country and by the states where tourists import them.

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## 3.1.5 Agricultural Ecosystem

### Crops

*Monoculture*. Traditional farming practices characterized by diverse cropping and varietal diversification are the best sources of agro-biodiversity. Traditional farmers are known to have great capability to generate and manipulate agrobiodiversity and are versatile in dynamic management of associated species, varieties, and other indigenous systems. In contrast, the commercial plantations and irrigated mono-rice culture are known users of one plant species which have narrow genetic base and have been vulnerable to extensive attacks of new forms of hitherto unknown pests and diseases. The massive damage by Tungro disease on IRRI rice in the Philippines is a clear example of the danger of monoculture or planting of one species over large areas to the exclusion of the traditional diverse land race species.

*Economic Priorities*. Many species, some endemic, are confined to the Cordillera region in the paddies of the rice terraces. Rice is planted in this region for local consumption and for the production of a

traditional beverage. Conversion of these lands into the more profitable vegetable farms will result in the irrevocable loss of these many species including endemic ones.

*Inappropriate Breeding/Genetic Erosion.* Formal breeding sectors reduce genetic variability rather than amplify it. Lessons from the past have shown that modern plant breeders have not served well in the developing countries. It was also felt that modern plant breeders have caused the reduction of diversity in major crops of the world (Wood, 1993). The US National Plant Genetic Resources Board noted that "it is imperative, therefore, that attempts be made to restore a necessary measure of genetic diversity through the use of new and unrelated sources of germplasm." While there is a recognition of the importance of multipurpose trees, multipurpose crops have been neglected.

*Improper Conservation.* The predominant practice is ex-situ conservation where collected samples are moved and stored in botanic gardens, or field collections kept in gene bank cold storage. Experiences show that wild and primitive cultivar collections are lost in the country of origin and that 50 percent of the original samples were normally lost during storage. Some seed collections are infected with seed-borne viral, fungal, and bacterial pathogens which persist for many years during storage. Thus, when moved internationally during germplasm exchanges, such problems are readily passed from plant to plant during field multiplication.

Domesticated Exotic Species

*Importation of Foreign Breeds.* With the aim of establishing the foundation for a sustainable, productive and economic domesticated exotic species industry, the Department of Agriculture launched the Medium-term Domesticated Exotic Species Development Program (1993-98). The program is basically one of importation estimated to cost the government about 61 billion pesos over a 6-year period. A special feature of the program is the improvement of local herds through intensive artificial/natural breeding. Importation of foreign breeding animals is not confined to the government program. The private sector is also engaged in it. The provision in the Rio de Janeiro convention that the introduction of alien species which threaten ecosystems, habitats, or species shall be prevented, controlled, or eradicated should be taken note of by all concerned.

Specific domesticated exotic species programs which involve the introduction of species are herein mentioned. The National Cattle Breeding Program called for the interbreeding of the local cattle population with Holstein Friesian, Sahiwal and American Brahman breeds with the aim of producing 87.5 percent dairy/12.5 percent beef cattle and 62.5 percent dairy/37.5 percent beef cattle. In the carabao breeding program, the Indian Murrah and the Pakistan Nili-Ravi breeds of buffaloes were selected to be crossed with the Philippine carabao. The selected breeds are known to produce, at 50 percent indigenous and 50 percent exotic genes, crossbreeds that have good draft power and with more meat and milk than the indigenous carabao.

*Loss of Grazing Areas.* Over the past decade, grazing area was reduced by about 65 percent. The causes are peace and order problem, kaingin or slash and burn agriculture, squatters, natural calamities and conversion of land to housing lots.

*Farmers' Lack of Awareness of Animal Genetic Resources Conservation.* Farmers generally prefer better domesticated exotic species with faster growth rate, earlier maturity, higher fertility, more eggs, meat and milk yield, stronger animal draft power, higher feed conversion efficiency, etc. Invariably, the farmer wants upgrading of his animals. And these are what the government's domesticated exotic species development program give the farmers. Farmers should therefore be made aware of government programs to upgrade domesticated exotic species and how these can be availed of.

## 3.2 Existing Mechanisms, Frameworks and Measures for Conservation and Sustainable Use

### 3.2.1 Forest Ecosystem

Forest Biodiversity Conservation Projects

*The Master Plan for Forestry Development.* The Master Plan was conceived to respond to the burgeoning problem of forest degradation by providing a framework that will ensure a systematic and coordinate effort at forest resources development and management. The general objectives of the Plan are: to meet the needs for wood and other forest products by placing all the country's production forest under sustainable management; to contribute to the production of food, water, energy, and other

needed commodities by properly managing the upland watersheds; protection of the land and its resources against degradation and ecological devastation through proper land management systems and practices; the conservation of the forest ecosystems and their diverse genetic resources; to contribute to employment and growth of national and local economies through fully developed forest-based industries; the promotion of social justice and equity and the recognition of the rights of ICCs in the management, conservation and utilization of forest resources.

There are 14 programs grouped under the three umbrella programs namely: Man and the Environment, Forest Management and Products Development; and Institutional Development.

The Man and Environment Programs include people-oriented forestry, soil conservation and watershed management, integrated protected areas system and biodiversity conservation, urban forestry, and forest protection.

The Forest Management and Products Development Programs include management of the natural dipterocarp forests, management of mangroves, pines and other natural forests, forest plantations and tree farms; wood-based industries, and non-wood forest-based industries.

The Institutional Development Programs include policy and legislation; organization, human resources, infrastructures and facilities; research and development; and education, training, and extension.

*Sagip Wildlife Program*. This is a national program developed through the concerted efforts of the DENR-PAWB, other government agencies and non-government sectors to infuse new strategies/ measures to make existing policy measures more effective, help create a resounding impact in terms of implementation and erase the negative impression of the public that the DENR has been remiss in its function to conserve and protect the wildlife resources.

The Program specifically aims to minimize and ultimately stop indiscriminate collection and trade of wild flora and fauna, to promote and encourage wildlife animal propagation through captive breeding and plant breeding, to strictly enforce wildlife legislations, and to conduct public awareness through massive information and education campaign on the values of wildlife conservation.

The cooperating institutions are the DENR, particularly the PAWB and its Regional Offices, the National Bureau of Investigation, Manila Mayor's offices, Haribon Foundation, and the Philippine Animal Welfare Society. Financial support was extended by the Foundation for Philippine Environment.

*Flora of the Philippines*. The Philippine National Museum (PNM), in collaboration with the Botanical Research Institute of Texas, (previously with the Bishop Museum, Hawaii) initiated this very important project to conduct a thorough inventory of the flowering plants of the country, build a comprehensive systematic record and specimen collection of various plant species in the country and consequently publish a Flora of the Philippines. The Project is composed of three components, namely: the Philippine Plant Inventory, Collections Management, and the Writing and Documentation Phase. The inventory activities include collection of herbarium specimens in 10 replicates, plant description and identification, habitat description,

plant processing, sorting, and distribution to different herbaria abroad. To date about 70,000 specimens have been collected throughout the country and are now distributed in the Philippines, US, European, and Asian countries. The writing phase will start in 1997 when enough botanical materials have been accumulated and processed. A Philippine Flora Newsletter published semi-annually informs the interested public about the progress of this project.

*Red Data Book on the Plants of the Philippines.* A comprehensive reference on rare and endangered plant species of the Philippines is the subject of research by D.A. Madulid and his staff at the PNM. It includes a list of plants, a short botanical description, assessment of threats, and conservation status description for each species. The research involves plant collection, field documentation, and herbarium and literature survey. The research is funded by the PNM and partially by funds from Japan.

*Red Data Book on Philippine Wildlife.* Research and publication on the conservation status of the different species of wildlife is being undertaken by the Wildlife Conservation Society of the Philippines, Inc. This project is supported by the Friends of the Zoo-Australia.

*Conservation of Biological Diversity in the Sierra Madre Mountains of Isabela and Southern Cagayan Province, Philippines.* The DENR and Birdlife International Philippines embarked on a joint project to survey and assess the biodiversity and habitats found in the Sierra Madre Mountains. The research involved primarily a survey of birds, ethnobiology of the indigenous people, and vegetation and land-use description. This was accomplished through literature survey, actual field research which included transect survey of birds, bioacoustics, mist-netting of birds, trapping of small mammals, aerial survey of vegetation, and land use. An extensive training and awareness program complemented the technical research which included training workshops, conferences, and lectures.

The project was funded by the Aage V. Jensen Charity Foundation. Other cooperating institutions were the Danish Ornithological Society, World Wildlife Fund, Conservation International, Haribon Foundation, PNM, Field Museum of Natural History in Chicago, Leiden University, University of the Philippines Los Baños, and Isabela State University. The project started in March 1991 and results were published in 1994.

*Sustainable Utilization of Non-Timber Forest Products in St. Paul's Subterranean National Park, Palawan.* Haribon Palawan, with technical assistance from the International Union for the Conservation of Nature and Natural Resources, and government agencies, namely PAWB, DENR Provincial Environment and Natural Resources Office (PENRO), Community Environment and Natural Resources Office (CENRO), Department of Agriculture, Municipal Government of Puerto Princesa City, the City Environment and Natural Resources Office (ENRO), University of the Philippines Los Baños, and the United Tribes of Palawan-Tribal Filipino Apostolate, is implementing a non-timber forest products project in three settlements of indigenous ethnic origin located on the northeast and northern boundaries of the St. Paul's National Park, Barangays San Rafael and San Roxas. The project site is the eastern buffer zone of the forests of the Park. The project aims to organize the local communities into area associations for sustainable management of their biological resources in order to achieve local economic development objectives. This will be accomplished with a survey of the commercially exploited products and promising species for sustainable and commercial use, collection and propagation of these species, and eventual sustainable harvesting, processing, and marketing of the species or its products by the local people. The 3-year project was funded by the European Union.

*Community-based Forestry Program (CFP).* This project aims to study and provide alternatives to logging concession workers when Timber Licensing Agreements (TLAs) are cancelled or cease to operate. The program includes the identification and validation of CFP sites and implementing NGOs, the formation of a Training and Research Consortium, Technical Advisory Group and Technical Working Group in the DENR and the designing of the CFP. The project adopts strategies of community organizing, capability building, policy development and advocacy, and linkaging and complementation framework.

The Foundation for the Philippine Environment, the John D. and Catherine T. MacArthur Foundation, and the DENR undertaken projects under this program.

*Subic Bay Forest Research.* A multi-institution research on the forest of Subic Bay is being coordinated by the Philippine Council for Agricultural Resources Research and Development-Department of Science and Technology (PCARRD-DOST). The research

involves a survey of the flora and fauna, ecology, ethnobotany of the Aetas, and pharmacological and genetic/DNA fingerprinting studies. Institutions involved are the University of the Philippines Diliman and Los Baños, Ateneo de Manila University, and the University of Santo Tomas Science Research Center.

*Long-term Ecological Research Sites.* Establishment of permanent ecological research plots has been initiated by the National Museum's Philippine Plant Inventory staff in three strategic different forest types and localities around the country. The plot set-up and research methodology have been designed following the Missouri Botanical Garden's procedure and is aimed at comparing the diversity of various forest habitats and the wildlife associated with each, namely, the mammal, bird, and invertebrate populations, and the fungi and microorganisms.

In 1989, a one hectare plot was established at the Irawan Flora and Fauna Reserve in Palawan. The plot represents a lowland evergreen rainforest formation within the Palawan Biogeographic Zone. The ecological data was taken and analyzed by a graduate student from the De La Salle University. The plant specimens have been identified at the Philippine National Museum Herbarium and at the Field Museum of Natural History, Chicago. The project was undertaken in cooperation with the University of Illinois at Chicago.

A submontane forest in Mt. Kitanglad, Bukidnon, Mindanao is the site of the first long-term ecological permanent plot established by the Philippine Plant Inventory Project as a joint endeavour of the PNM and the Botanical Research Institute of Texas, Inc. The plants were identified at the PNM, Kew Botanic Gardens, and US National Herbarium. The results of the study were presented at Washington, D.C. during the Man and the Biosphere (MAB) International Symposium of Biodiversity Assessment and Monitoring on May 23-24, 1995.

The same research methodology was duplicated at Mt. Guiting-Guiting, Sibuyan Island. A forest over ultrabasic soils was sampled in the research. The plants are currently being identified at the PNM, Kew Botanic Gardens, and US National Herbarium.

Another long-term ecological research plot was established at a lowland evergreen rainforest at the Bicol National Park by the National Museum in 1991. The research was undertaken in consonance with the park management program of the Bicol National Park Foundation, Inc. The results of vegetation analysis and biodiversity study were submitted to the DENR.

*Establishment of the Biodiversity Information Center.* In 1993, the PNM received a 3-year grant from the John D. and Catherine T. MacArthur to establish a Biodiversity Information Center. The Center aims to provide primary and secondary information on plants and animals to the general public. The activities involve field research to gather primary first-hand information on biodiversity-rich areas in the country, synthesize in layman's language the voluminous biodiversity research, gather and maintain a computerized data base on local and foreign publications dealing with plant diversity, taxonomy, ecology, etc., organize and maintain a library on plant diversity and related subjects for use of researchers, students and the general public, provide training courses on plant diversity and conservation techniques, and publish researches. Another main task of the Center is to build plant and animal information data-bases which are based on the National Museum's extensive collections of natural history specimens and other relevant information from the staff's field research.

Other on-going research projects related to Forest Biodiversity Conservation are listed in Annex I.

## Forest Biodiversity Conservation Methods

*IN-SITU PROGRAM*

Included in the IPAS I are ten priority sites chosen primarily on the basis of high biodiversity significance.

The ASEAN Declaration on Heritage Parks and Reserves signed in Bangkok on 29 November 1984 declared certain conservation areas for management to maintain and protect ecological processes, biodiversity, and their other values. For the Philippines, Mt. Apo National Park, and Mt. Iglit-Baco National Park were chosen and declared as ASEAN heritage sites and reserves.

Mount Iglit-Baco National Park was chosen for the conservation of the remaining population of tamaraw, *Bubalus mindorensis*. From an estimated count of 10,000 tamaraws in 1900, the figure declined to 100 heads in three subpopulations. This critical situation prompted the implementation of measures to preserve the original habitat of the tamaraw as well as ex-situ measures such as captive

breeding of the species in Canturoy, Rizal (Cox, 1991).

Mt. Apo National Park was likewise chosen to conserve another endangered species, the Philippine eagle, *Pithecophaga jefferyi*.

*EX-SITU PROGRAMS*

Botanical gardens

*UP Quezon Land Grant Botanic Garden.* This botanic garden covers total land area of 144 hectares. It is found in Llavac, Municipality of Real, Quezon Province 120 km from Manila. Located 1,000 to 1,500 ft. above sea level, it used to be a showcase of pristine lowland evergreen rainforest. Dipterocarps, orchids, palms, aroids, and other species, commonly found in this forest type are well represented. There used to be an herbarium and orchidarium with specimens representing local species. Because of the deteriorating peace and order situation in the site, the Garden has been abandoned. The Institute of Biological Sciences-University of the Philippines Los Baños is in charge of the technical and financial management of the Garden. In 1993, the National Research Council of the Philippines negotiated a 1M pesos grant from the Philippine Amusement and Games Corporation through the auspices of the Office of the Vice President for the upkeep of the Land Grant.

*Makiling Botanic Gardens.* The Makiling Botanic Gardens is a unit of the Institute of Forest Conservation, College of Forestry, University of the Philippines at Los Baños. It was established in 1963 by virtue of Republic Act 3532. The garden occupies 300 hectares of forests located 100-600m above sea level on Mt. Makiling, 65 km southeast of Manila. The garden has an arboretum, a nursery, and recreational areas. Several indigenous and exotic species are found in the garden. Problems of squatting, land development, and kaingins beset Mt. Makiling.

*The Living Museum of Philippine Medicinal Plants.* A garden of medicinal plants is found in the Quezon Memorial Circle, Diliman, Quezon City. It is a showcase of indigenous plants used to remedy common household illnesses. Many of the plants are found in the forest and traditionally used by indigenous cultural communities. This program seeks to promote the conservation and propagation of Philippine medicinal plants, particularly those species which are indigenous and rare. It also aims to increase public awareness about biodiversity conservation, alternative health care, and environment. The garden is managed by the Philippine Institute of Alternative Futures, Inc.

Gene Bank

There are gene banks established in the country to serve as off-site conservation areas and sources of germplasm for reintroduction to original habitats or introduction to new habitats. These include the Rattan Gene Bank, the Bambusetum and the Palmetum which are maintained by the Ecosystems Research and Development Bureau.

Seed bank

*International Rice Research Institute Germplasm Center.* A rice seed bank is maintained by the International Rice Research Institute at Los Baños, Laguna. It is the largest seed bank for rice in the world. It has seeds from all rice-growing countries in the world systematically stored in specially built rooms kept at sub-zero temperatures. Seeds are available for research and can be requested.

Zoological Gardens

*The Manila Zoological and Botanical Garden.* Established during the American period, the Zoo is now run by the City of Manila. At present, the Zoo badly needs rehabilitation and infrastructure upgrading.

Wildlife Sanctuary

*Calauit Wildlife Sanctuary, Palawan.* Calauit Island was declared a sanctuary to serve as an outdoor refuge of many exotic and endemic wildlife species in danger of extinction. Some of the endemic species grown in the wild or in captivity are the mousedeer *(Tragulus napu)*, Calamian deer *(Axis calamianensis)*, bear cat *(Arctictis binturong)*, and Palawan peacock pheasant *(Polyplectron emphanum)*. These animals live harmoniously with African wildlife species like giraffe, zebra, topi, impala, bushback, gazelle, waterbuck, and eland.

Captive Breeding Programs

Efforts to save several Philippine endangered species from extinction outside of their natural habitats have been recently launched by the government and proven to be successful. Reintroduction into the wild, the final phase to complete the ex-situ objectives, have yet to be undertaken.

One of the endangered animals with an ex-situ conservation program is the Visayan spotted deer, *Cervus alfredi*. The species has disappeared in its original forest habitats in Cebu, Bohol, Siquijor, Masbate, and Guimaras because of extensive degradation of the habitat and overhunting. Only small scattered populations now remain. In 1987, an agreement was forged between the DENR and the Mulhouse Zoo in France for the conservation of the deer. Founder stocks of the deer are now bred in the Mulhouse Zoo. Local breeding facilities have also been established in Bitu Farm in Barangay Gutao, Iloilo and in Silliman University.

A similar ex-situ conservation program is being undertaken for the Visayan spotted deer, *Cervus alfredi* and the Visayan warty pigs, *Sus cebifrons*, in the Melbourne Zoo through a Memorandum of Agreement signed by the DENR with Silliman University. The program falls under the Zoo's conservation and research activities under the International Recovery Program. Other institutions involved are the West Visayas State University, the Negros Ecological Foundation and the Flora and Fauna Preservation Society. The production of the Philippine Red Data Book is also supported by the Melbourne Zoo.

The Philippine eagle, under the Philippine Eagle Foundation, Inc. and the Philippine Eagle Conservation Program, has been successfully bred in captivity in a farm in Davao. This eagle, with other rare and endangered species, are also bred in captivity at the Philippine Raptor Research and Conservation Center in Mt. Makiling, Laguna.

The long-tailed macaque or *Macaca fascicularis*, the only monkey species found in the Philippines, is bred in captivity for international trade. Due to the restrictions in the trade of the species, a local private company engaged in the export business established the Simian Conservation Breeding and Research Center (SICONBREC), a breeding farm for monkeys for the export trade. The captive breeding of this monkey species is a success story which has made the company the world's largest breeder of captive monkeys. Five other companies are engaged in the business namely, A.T. Virri Primate Breeding Corporation, Del Mundo Trading, Ferlite Scientific Research, Inc., Amo Farm, and Scientific Primates Filipinas, Inc.

A conservation program for the Philippine cockatoo, *Cacatua haematuropygia*, was initiated in 1992. The ex-situ aspect includes an officially approved European Endangered Species Breeding Program (EEP) and laboratory research which includes karyotyping, genetic and hematological studies (Boussekey, 1995).

Other captive breeding projects in the Philippines include the Tamaraw Conservation Program under the PAWB, the Biological Study of Asiatic Pangolin in its Natural Habitat and in Captivity under the Ecosystems Research and Development Bureau (ERDB); and Crocodile Conservation Program under the Crocodile Farming Institute in Palawan.

### 3.2.2 Conservation of Wetland Ecosystem

The concepts of sustainable use and integrated planning and management took its roots in Philippine program development levels of government in the early 90s. Preparation of the 1992 National Wetland Action Plan attested to this. The Philippine Wetlands Strategy and Action Plan was designed to protect and conserve whatever remains of the biodiversity and biological resources of wetlands, and to lay down in a judicious manner the groundworks for the regeneration of what has been lost. Two important documents were used in the Plan preparation, namely, the Philippine Strategy and Action Plan for Biological Diversity Conservation (PSBDC) and the 1992 National Wetland Action Plan for the Republic of the Philippines. The former served to lay down the basic framework for the Plan. It identified the fundamental aspects of biodiversity and management that had to be addressed. The latter abounds in specific actions but is wanting in terms of coherence and organization towards identified goals and objectives. Nonetheless, because of its richness in site specific actions, it is a substantive input around the basic framework of the PSBDC.

One of the projects currently being implemented to conserve biodiversity is the "Lake Fisheries Productivity and Quality Enhancement" under the umbrella program entitled "Basin Approach to Lake Management (Laguna de Bay)" of the Department of Science and Technology (DOST). This project aims to integrate current and future researches to stop further deterioration of Laguna de Bay and improve water quality to enhance the aquatic productivity of the lake. Specifically, this addresses concerns on the lake's water quality and the state of its fishery resources.

There are four interrelated components under the said project, namely: (1) Lake Environment Information System (LEIS), (2) Lake Environment Monitoring System (LEMS), (3) Lake Environment

Social Mobilization Program (LESMP) and (4) Lake Environment Policy Studies (LEPS).

Insofar as wetland insects are concerned, they are hardly considered in any of the existing Mechanisms and Framework or Strategies and Action Plans for Conservation in Wetlands or in any ecosystem for that matter, e.g. PSBDC, Wetlands Action Plan, Laguna de Bay Master Plan, Wildlife Act and the like. Their inclusion into these plans is strongly urged for better understanding of the existing food webs in wetland habitats and the role that insects contribute to the productivity of commercially important biological species such as fish. Their potential as indicators of the quality of the habitat should also be explored. Actual surveys of insects in wetland and even terrestrial habitats within protected areas, as in the NIPAS' surviving Natural Parks and famous volcanic mountains, Game Refuge and Bird Sanctuaries (GRBS) and important lakes and rivers must be conducted by insect systematists if the biodiversity of Philippine insects is to be better understood. In this regard, the involvement of capable entomologists in biodiversity planning processes is in order.

*Survey of Selected Insect Groups in Philippine Wetlands.* Since this inventory is based mainly on literature, actual surveys of important insect groups in specific wetland habitats within the NIPAS and selected Natural Parks are proposed to be conducted by a team of insect systematists from UP Los Baños. Description of specialized habitats of inclusive species as well as description of new endemic species encountered should be made. Attempts will be made to retrieve previously described endemic species and preserved representative specimens from various sources and placed at the UPLB Museum of Natural History. Selected groups are Ephemeroptera, Odonata, Plecoptera, the orthopterous family Tetrigidae, Hemiptera, Coleoptera, Trichoptera and the dipterous family Tipulidae, which will sufficiently characterize each IPA or natural park. All wetland types, such as rivers and streams, ponds and lakes, will be covered by the survey. The inclusion of the rapidly deteriorating National Botanic Garden in Real, Quezon is suggested. Selected natural parks are the Cordillera and Sierra Mountain Ranges, the Zambales Mountains, Mt Arayat (Pampanga), Mt Banahaw (Laguna and Quezon sides), Mt Makiling (Laguna), Mt Isarog (Camarines Sur), Bulusan Volcano (Sorsogon), Mt Halcon (Oriental Mindoro), Cuernos Mountains (Negros Oriental), Mt Malindang (Misamis Occidental) and Katanglad Mountains (Bukidnon), all of which, in high probability, harbor many endemic species within their rivers, streams and lakes, and other wetlands. Wetland habitats of Palawan, especially along its mountainous areas, have not been adequately studied, and this could constitute a separate project. Providing funding for short-term collecting expeditions, preferably in the summer months, is strongly urged.

The Fisheries Management and Development Plan (FMDP, 1993-1998) indicates that the government for its part, through the DA, will focus on the following concerns: (1) regeneration, conservation, and sustained management of the country's aquatic resources; (2) environmental rehabilitation and protection of the coastal zone; (3) poverty alleviation and occupational diversification among marginal fisherfolk; (4) intensification of aquaculture; and (5) optimal exploitation of offshore, deep sea resources. To attain the objective of the plan, the following strategies are specified by the Bureau of Fisheries and Aquatic Resources (BFAR).

A. Resource Management Strategies:
   - A.1 Regulation of fishing efforts to within sustainable yield (SY) levels.
   - A.2 Institution of a new management system for coastal areas.
   - A.3 Institution of coordinated environmental management of land- and marine-based resources.

   Other strategies to be implemented in coastal areas are:
   - (a) coastal resource management of naturally demarcated bays, gulfs, and reefs;
   - (b) promotion of territorial use rights in fisheries (TURF) for small fisherfolks;
   - (c) conservation of coral reefs, mangroves, and seagrasses in good condition; and
   - (d) regeneration of damaged habitats.

B. Supply Enhancing Strategies:
   - B.1 Expansion of domestic production only at minimum levels.
   - B.2 Increasing exports.
   - B.3 Strengthening of the marketing system particularly through continuous implementation of infrastructure projects and expansion of postharvest services.

C. Socioeconomic Strategies:
   - C.1 Intensification of extension services on production and post harvest technologies

and facilities as well as credit and establishment of fisherfolk cooperatives.

Proposed and Existing Projects

The fisheries program and related projects and activities including local and foreign-assisted plans and projects of the country are being operationalized and implemented by various institutions such as the DA-BFAR, BAR, and DA Regional Field Offices; DENR-LLDA, DOST-PCAMRD; BAS; SUCs; SEAFDEC; ICLARM; NGOs and some contracted consultancy groups.

Refer to Tables 81a-81c for further listings of projects.

Due to the limited time, only the DA-BFAR concerns are enumerated hereunder. As embodied in the Fisheries Management Development Program (FMDP) 1993-1998 prepared by BFAR, the following interventions are specified in relation to aquaculture and Inland fishery resources as well as support services:

A. Resource Management Interventions

A.1. Management and conservation of habitat such as mangroves and coral reefs

As an agreement between the DA and the DENR and upon review, all areas shall be reverted to the DENR under the following criteria: (1) areas found unsuitable for fishpond purposes; (2) areas not yet covered by Fishpond Lease Agreement (FLA) except for those already developed and occupied, and (3) FLA's of areas not processed and approved in a given period.

A.2 Research and establishment of a data support management system

B. Interventions to Ensure Sufficient Supply

B.1 Measures to increase domestic production

*Brackishwater Aquaculture*. For mangrove protection, no more expansion of brackishwater fishponds will be allowed.

*Freshwater Aquaculture*. A recorded 14,531 hectares of freshwater fishponds in the country is targeted to be expanded at a minimum of 0.05 percent per annum; of this, 65 percent or 9,432 hectares in Region 3 that were less affected by mudflows will be rehabilitated.

*Inland Fisheries*. This includes development of lake fisheries, reservoirs, dams and small water impoundment fisheries.

*Fish Pen and Cage Culture in Lakes and Reservoirs*. Expansion of fish pen areas will be limited within the identified fishpen belt zones. In areas like Laguna de Bay and other bodies of water overcrowded with aquaculture activities, fishpen expansion will no longer be permitted.

*Mariculture*. Existing methods in oyster and mussel farming will be improved and potential areas for mariculture will be tapped.

B.2 Measures to increase profit

Government support will be provided for traditional fisheries by strengthening the Fish Inspection and Quality Control Program through: (a) establishment of appropriate product standards; (b) formulation of Fisheries Administrative Orders (FAOs) from catch and/or harvest to market; (c) amending the rules and regulations on the operation of Fish and Fishery Products Processing Plants (FAO No.177); and (d) reviewing the rules and regulations governing the issuance of permits or commodity clearance for the exportation of fish and fishery/aquatic products (FAO No 147).

C. Interventions to Alleviate the Socioeconomic Plight of Subsistence Fisherfolk

These include provision of access to coastal resources; improvement of the economic condition in coastal communities; and strengthening of social services in coastal areas.

D. Interventions to Develop the Required Infrastructures

D.1 Operational improvement of the three commercial ports in Navotas, Iloilo, and Zamboanga;

D.2 Establishment of new port facilities in the General Santos Agricultural Processing Center;

***Table 81a** On-going Department of Agriculture (DA) research projects and related activities on aquaculture and inland fisheries*

| TITLE | PROPONENT / LOCATION | DURATION |
|---|---|---|
| Assessment of Physical and Chemical Properties of Irrigation Water from Mt. Pinatubo-Affected Irrigation System | DA-Central Luzon Integrated Agricultural Research Center (CLIARC) Tarlac, Region 3 | 24 Months 1994-1995 |
| Milkfish Research and Development (R & D) Activities | DA- CLIARC Research Outreach Station (ROS) for Brackishwaters Hagonoy, Bulacan, Region 3 | 1994-1995 |
| | DA- Ilocos Integrated Agricultural Research Center (ILIARC) Sto. Tomas, La Union, Region I | |
| | DA- ILIARC-ROS for Marine Lucap, Alaminos Pangasinan | 1993-1998 |
| | DA- Ozamis City, Surigao del Norte and Butuan City | 1993-1995 |
| | DA-ROS Tagabuli, Region XI | 1993-1995 |
| Catch Efficiency of Fish Pots (Chicken Wire and PE Screen) | DA-ROS for Freshwater Mariveles, Bataan and Masinloc, Zambales | 1994-1995 |
| Eucheuma Research and Development<br>- *Eucheuma spinosum*<br>- *Eucheuma staritu*<br>- Other Seaweeds | DA-ROS for Freshwater Masinloc, Zambales<br>DA-Ozamis City and Camiguin Is.<br>DA-ROS Tagabuli, Davao, Region XI | 1994-1995<br>1993-1995<br>1993-1995 |
| Marine Fish Culture Research and Development Program<br>- Grouper<br>- Siganid<br>- Emperor Fish (*Letrinus* sp.)<br>- *Epinephelus tauvina* | DA- ILIARC, Sto. Tomas, La Union<br>DA- ILIARC-ROS for Marine Development Zone Lucap, Alaminos, Pangasinan<br>DA-Camiguin Island and Ozamis City | 1992-1995<br>Continuing<br>1992-1995 |
| Coastal Resource Management | DA-ILIARC Lingayen Gulf, Pangasinan | 1993-1997 |
| Freshwater Aquaculture Research and Development<br>-Tilapia<br>-Carp<br>-Catfish (*Clarias macrocephalus* )<br>-Integrated Fish Farming | DA-ILIARC, Paoay, Ilocos Norte<br>DA-WESVIARC, Iloilo Region<br>DA-Agusan del Norte<br>DA-ROS, Nabuntaran, Region XI | 1994-1998<br>1992-1996<br>1994-1995<br>1993-1995 |
| Study on Pond Snail Eradication | DA-ROS-IBDFF Pangi, Ipil Zamboanga del Sur | 1994-1996 |
| Monitoring of Red Tide at Taguines Lagoon | DA Banoni Lagoon Camiguin Is. | 1993-1995 |
| Assessment on the Productivity of Fishponds | DA Placer and Gigaguit Surigao del Norte | 1994-1995 |
| Crustaceans Research and Development | DA Ozamis City, Surigao del Norte Butuan City | 1993-1995 |

***Table 81b*** *FSP-NFRP on-going research projects on aquaculture*

| TITLE | PROPONENT/ LOCATION | DURATION | STARTING DATE |
|---|---|---|---|
| Program IV - AQUACULTURE | | | |
| 1. Assessment and Improvement/Refinement of Grow-out Technology for Milkfish, *Chanos chanos*<br>I. Studies on the Dynamics of Brackishwater Milkfish Ponds Using Extensive and Intensive Culture System<br>a. Variations in the Primary and Secondary Production and Species Composition<br>b. Forms of Nitrogen, Phosphorus, & Carbon and Their Inter-Conversion<br>II. Verification and Field Trials of the New Milkfish Trial Technology | A. Marasigan<br>U.P. in the Visayas | 30 months | July 1992 |
| 2. Optimum Protein and Energy Ratio in Grouper *Epinephelus sp.* | A. Serrano<br>U.P. in the Visayas | 24 months | July 1992 |
| 3. River Pollution: An Investigation on the Influence of Aquaculture and Agro-Industrial Effluents to the Communal Waterways<br>a. Effect of Aquaculture Effluents<br>b. Effect of Agriculture Effluents<br>c. Effect of Industrial Effluents<br>d. Effect of Domestic Effluents<br>e. Survey of the Fishfarming, Aquaculture, Industrial and Household Practices Around Study Site | G. Almazan-Gonzales<br>U.P. in the Visayas<br><br>E. Taberna<br>C. Saclauso<br>H. Gonzales<br>G. Gonzales<br>L. Catedrilla | 24 months | January 1992 |
| 4. Health Management of Prawn and Milkfish Hatchery<br>a. Bacteriological Studies of Prawn and Milkfish Hatchery System<br>b. Mycological Studies of a Prawn and Milkfish Hatchery System | J. Torres<br>U.P. in the Visayas<br>J. Torres<br>V. Gacutan | 24 months | January 1993 |
| 5. Abundance and Farming of Epinephelus species and Scylla *serrata* in Panay Island<br>a. Abundance of Mudcrab (*Scylla serrata Forsskal*) in the Intertidal and Mangrove Areas: A Competitive Study<br>b. Effect of Various Stocking Densities and Types of Food on the Growth, Survival and Net Yield of Grouper, *(Epinephelus suillus)* Cultured in Floating Cages<br>c. Study on the Biology and Ecology of *Epinephelus sp.*in Capiz, Panay Island | N. Solis<br>SEAFDEC<br>N. Solis<br><br>E. Amar<br><br>N. Solis | 12 months | December 1992 |
| 6. Milkfish Broodstock Management<br>a. Effects of Dietary Lipid Levels and Ration Size on the Reproductive Performance of Milkfish Broodstock<br>b. Determination of Optimum Dietary Protein Level for Milkfish Broodstock | A. Emata/SEAFDEC<br>C. Marte<br><br>A. Emata/I. Borlongan | 30 months | July 1992 |

*Cont'n.* ***Table 81b***

| TITLE | PROPONENT/ LOCATION | DURATION | STARTING DATE |
|---|---|---|---|
| c. Effects of Vitamin E Supplementation on the Reproductive Performance of Milkfish Broodstock | A. Emata/I. Borlongan | | |
| d. Age and Reproductive Performance of Milkfish Broodstock | A. Emata | | |
| 7. Evaluation of Practical Feeds of Catfish *(Clarias macrocephalus)* Broodstock | C. B. Santiago SEAFDEC | 24 months | December 1992 |
| 8. Feed Development for Seabass *(Lates calcarifer* Bloch) Juveniles Based on Inexpensive and Indigenous Ingredients | R. Coloso SEAFDEC | 24 months | December 1992 |
| 9. Utilization of Low-Cost Indigenous Materials as Feed Ingredient for Fish and Crustacean | O. M. Millamena SEAFDEC | 24 months | December 1992 |
| a. Evaluation of Low-Cost Feed for *Penaeus monodon* Semi-Intensive and Intensive Reared Under Culture Conditions in Brackishwater Ponds | O. M. Millamena | | |
| b. Nutritional Evaluation of Some Leguminous Seeds as Protein and Energy Sources for Seabass | P. Eusebio | | |
| c. Evaluation of Eucheuma *(Kappahycus sp.)*and Gracilaria *(Gracillariopsis heterociada) as Binders for* Shrimp *(P. monodon)*Juvenile Diets | N. Golez | | |
| 10. Polyculture for *Gracilaria heteroclada* and *Penaeus monodon*in Brackishwater Ponds | A. Hurtado Ponce SEAFDEC | 12 months | December 1992 |
| a. Polyculture of *G. heteroclada* and *P. monodon* in Brackishwater Ponds | A. Hurtado Ponce | | |
| b. Seasonal Variation in Agar Quality and Quantity of G. heteroclada Cultured in Ponds | T. Castro | | |
| c. Economic Feasibility of the Polyculture of Seaweed of Seaweed (*Gracilaria* sp.) with Tiger Prawn *(P. monodon)*in Brackishwater Ponds | R. Agbayani | | |
| 11. Hatchery and Nursery Techniques For Milkfish *(Chanos chanos):* Development of Improved and Alternative Methods | C. Marte SEAFDEC | 30 months | July 1992 |
| a. Development of Practical Diets for First-Feeding and Older Larvae of Milkfish | I. Borlongan | | |
| b. Alternative Rearing Schemes for Milkfish Larvae | C. Marte | | |
| c. Verification and Economic Analysis of Improved Hatchery Techniques for Milkfish Developed at SEAFDEC/AQD | M. Duray | | |
| 12. Broodstock of Development and Seed Production of the Freshwater Asian Catfish, *Clarias macrocephalus* | J. Tan-Fermin SEAFDEC | 24 months | December 1992 |
| a. Improvement of Hatching Efficiency in the Asian Catfish *(C. macrocephalus Gunther)*Eggs | J. Tan-Fermin/ P. Subosa | | |
| b. Spontaneous Spawning of *C. macrocephalus* | L. Ma. Garcia | | |

*Cont'n.* ***Table 81b***

| TITLE | PROPONENT/ LOCATION | DURATION | STARTING DATE |
|---|---|---|---|
| c. Refinement of hatchery and Nursery Techniques for the Mass Production of Asian Freshwater Catfish, *Clarias macrocephalus* | A. C. Fermin | | |
| 13. Breeding of Grouper in Captivity | G. Quinitio/SEAFDEC | 30 months | July 1992 |
| a. Reproductive Biology of *E. suillus* in Captivity | G. Quinitio | | |
| b. Induction of Sex Inversion of Grouper *(E. suillus)* Using Various Methods of Chronic Administration of 17-alpha Methyltestosterone | C. Marte | | |
| c. Effect of Different Fat Sources on the Egg Quality of *E. suillus* | G. Quinitio | | |
| d. Development of Larval Rearing Techniques for *E. suillus*: food and feeding | M. Duray | | |
| 14. Development of Pond Reared *P. monodon* Broodstock | M. Consulta/BFAR | 12 months | July 1992 |
| 15. Development of Azolla Utilization in Aquaculture | A. Cagauan/CLSU | 24 months | December 1992 |
| a. Development of Azolla as Fish Feed | | | |
| b. Azolla Use and Its Economics in Integration Rice-Fish Farming System | | | |
| 16. Refinement of Cage Culture Technology of *Penaeus monodon* | J. Genodepa UPV-IA | 12 months | September 1993 |
| 17. Assessment of Grouper species in Selected Waters at Zamboanga and Basilan | N. Lasola/R. Samson ZSCMST | 15 months | October 1993 |
| 18. Development of Hatchery Techniques for Kapis, *Placuna placenta* | J. Ladja SEAFDEC | 15 months | October 1993 |
| a. Evaluation of Broodstock Management Techniques for *P. placenta* | | | |
| b. The Effects of Salinity and Algal Food Supplement on the Growth and Survival of *P. placenta* | | | |
| 19. Culture of *Gracilaria verrecusa* in Brackishwater Ponds | C. Jumawan/R. Palma DA-XII-ROS | 12 months | January 1994 |
| 20. Treatment Schemes and Alternative Culture Systems for the Utilization of Waste Water from Intensive Prawn Brackishwater Ponds | N. Fortes/V. Corre UPV-IA | 12 months | January 1994 |
| a. Characterization of the Effluent from Intensive/ Semi-Intensive Culture of Prawns | | | |
| b. Transformation of Waste Water Using Biological and Physical Methods of Treatment | | | |
| 21. Mudcrab Grow-out Culture Techniques | A. Triño/SEAFDEC | 12 months | January 1994 |

*Cont'n.* ***Table 81b***

| TITLE | PROPONENT/ LOCATION | DURATION | STARTING DATE |
|---|---|---|---|
| 22. Lipid Requirement and Feed Development of Grouper, *Epinephelus*species | A. Serrano/UPV | 12 months | January 1994 |
| a. Evaluation of Two-Feed Forms Using Various Animal Plant Protein Ratios for Grouper *E. tauvina* | E. Marasigan UPV | | |
| b. Dietary Lipids for the Semi-Purified Feeds of Grouper Juveniles | Z. Feliciano UPV | | |
| 23. Reproductive Biology, Gonadal Maturation and Spawning of *Pholas orientalis* | L. Laureta UPV-IA | 12 months | January 1994 |
| a. Reproductive Biology and Induction of Spawning of *P. orientalis* | L. Laureta | | |
| b. Broodstock Maintenance and Gonadal Maturation of *P. orientalis* | E. Marasigan | | |
| 24. Development of Hatchery and Grow-out Techniques for Kapis, *Placuna placenta* | S. Santos UPV-IA | 12 months | January 1994 |
| a. Development of Transplantation Techniques for Kapis, *P. placenta* | | | |
| b. Induction of Spawning in *P. placenta* placenta through Physical Means | | | |
| c. The Effect of Different Water Treatments on the Survival of *P. placenta* Larvae | | | |
| 25. Adaptability and Verification Trials on the Culture of Selected Finfishes | N. Domenden DA-Region I | 12 months | January 1994 |
| a. Comparative Study on the Growth & Survival of Hatchery Produced and Wild Caught Bangus Cultured in Net Cages | N. Domenden | | |
| b. Growth Comparison of Selected Sex Reversed *Tilapia nilotica* strains in Brackishwater ponds | R. Gaerlan | | |
| c. Feeding Trials of Sex Reversed *Tilapia nilotica* Cultured in Brackishwater Net Cages | | | |
| 26. Adaptation of Fish-Livestock Poultry Integrated Agri-Aqua-Culture Farming Systems | G. Alcober DA-VIII-ROS | 9 months | April 1994 |
| 27. Effects of Various Salinity on the Morphology, Growth and Agar Content of *Gracilaria* spp. Cultured in Tanks (Thesis Research) | S. Ferrer BFAR | 6 months | March 1994 |
| 28. Comprehensive Evaluation of Low Milkfish Production in the Province of Palawan (Thesis Research) | E. Dumada-ug PNAC | 6 months | March 1994 |
| 29. Growth and Survival of Grouper at Different Stocking Densities in Brackish- | A. Tarabasa DA-XII-ROS | 9 months | April 1994 |
| 30. Comparative Evaluation of Growth and Survival of Mudcrab in Brackishwater Ponds With and Without Shelter | A. Abogado DA-XII-ROS | 9 months | April 1994 |
| 31. Grow-out Culture: Comparison of Different Materials as Crab Shelter | M. Basaya DA-IV-ROS | 9 months | April 1994 |

*Table 81c Laguna Lake Development authority (LLDA) sectoral projects and programs*

| PROJECT | LOCATION | STATUS |
|---|---|---|
| Agricultural Development | | |
| Mabitac Irrigation Demonstration Farm | Mabitac, Laguna | Ongoing |
| Farm Service Centre | Mabitac, Laguna | Ongoing |
| Vegetable Truck Garden Project | Tanay, Rizal | Defined |
| Laguna de Bay Floating Weed Removal and Its Utilization as Agricultural Compost | | Proposed |
| Environment (Monitoring and Protection) | | |
| Environmental Management Program for the Laguna de Bay Region | | Ongoing |
| Pangalagaan Ang Ating Lawa (Save Our Lake Program) | | Proposed |
| Fisheries Development | | |
| Demonstration Fish Pen Project | Looc, Cardona, Rizal | Ongoing |
| Laguna de Bay Fish Pen Development Project | Laguna | Ongoing |
| Laguna de Bay Fishery Management Program | Laguna | Ongoing |
| Seeding of the Lake | | Ongoing |
| Forest Development | | |
| 180 ha Bamboo Plantation Project | Pakil, Laguna | Terminated |
| 200 ha Fruit Tree Farm Plantation Project | Tanay, Rizal | Terminated |
| Bamboo Farm Demonstration Project | Talim Island | Terminated |
| Industrial Development | | |
| Talim Tourist Development Project | Proposed Alternative Sites (Talim and Pulong Punta Jala Jala) | Suspended |
| Infrastructure | | |
| Mabitac Irrigation Project | Mabitac, Laguna | Terminated |
| Teresa Groundwater Exploration | Teresa, Rizal | Deferred due to lack of funds |
| Pilot Community Water Supply | Teresa, Rizal and Victoria, San Pedro, Laguna | Deferred due to lack of funds |
| Looc Pilot Water Treatment Plant | Bo. looc, Cardona, Rizal | Terminated |
| Water Quality Management Program | Laguna Lake | Ongoing as regular agency function |
| Interceptor Sewer Project | Laguna Lake West Shore and East Marikina | Deferred |
| Solid Waste Management Projects | Lakeshore Towns | Deferred |
| Lake Ports Development | Sta. Cruz and Calamba in Laguna, Tanay in Rizal | Deferred |

*Cont'n.* ***Table 81c***

| PROJECT | LOCATION | STATUS |
|---|---|---|
| Flood Control (Implementation by Bureau of Public Works | | |
| Hydraulic Control Structure | Confluence of the Napindan, Marikina, and Pasig Rivers | Operational |
| Manggahan Floodway | Bo. Manggahan, Marikina to Laguna de Bay | Construction ongoing |
| Parañaque Spillway | Bo. Sucat, Parañaque to Manila Bay | Suspended |
| National Power Corporation) | | |
| Kalayaan Water Storage Project | Kalayaan, Laguna | Operational |
| Mt. Makiling - Mt. Banahaw Geothermal project | Bo. Bitin, Bay, Laguna | Operational |
| Irrigation (Implementation by National Irrigation Agency) | | |
| Laguna de Bay Irrigation Project | Laguna and Rizal | Operational |
| Friar de bay Irrigation Project | Cavite | Construction ongoing |
| Others | | |
| Management Program for the Seven Lakes in San Pablo City | | Ongoing |
| Livelihood Development Program Project | | Ongoing |
| Comprehensive Water and Land Resources Development Planning Study | | Proposed |
| East Marikina Lakeshore Interceptor Feasibility Study Updating | | Proposed |

*Sources: Borja-Santos, 1991 and Cardenas et al. 1987*

D.3 establishment of a new nationwide ice plant and cold storage network system with nodes in Zambales, Camarines Norte, Iloilo, and South Cotabato;

D.4 establishment of fish transport systems in Camarines Norte, Iloilo, Capiz, and South Cotabato;

D.5 establishment of integrated fish trading complexes in Zambales, Bulacan, Pampanga, Nueva Ecija, Tarlac, and Navotas.

E. Interventions to Strengthen Institutional Capabilities

Organizational structures and functional relationships among fisheries activity related institutions have been established.

### 3.2.3 Conservation of the Marine Ecosystem

Conservation of biodiversity requires changes in the ways we think and act. Focusing solely on species has proven to be insufficient and ineffective in efforts to protect the sea. Protection and management of the ecosystem are essential complements to protect species. Critical marine areas that merit the highest priority for protection include those with high diversity and/or high endemism, or high productivity like spawning and nursery areas, and migration stop-overs and bottlenecks. Large marine ecosystems based on biogeographic provinces offer a promising way to manage the ocean holistically. The goal of such endeavor should be to ensure that living things should not be endangered, i.e., to maintain the integrity of life. This means not only keeping the parts (genes, species, ecosystems) but also the

processes that generate and maintain the parts, the ecological connections among living things.

### Past, Existing, and Proposed Projects

Research on coral reefs, seagrass beds, soft bottom communities and mangroves was considerably enhanced through the implementation of the ASEAN-Australia Economic Cooperation Program (Marine Science): Living Coastal Resources Project in 1986-1994. This program, together with the ASEAN-US Environmental Program implemented in the mid-1980s, coordinated researchers across the region involved in training, method development, field research, and database management. The Fisheries Stock Assessment Collaborative Support Program of USAID implemented also in the mid-1980s focused on the development of methods and analytical approaches and on providing training. The combination of these programs has resulted in a large group of well-trained researchers endowed with modest funds for regionally standardized fieldwork who produced and are still producing substantial material on the ecology and management of shallow water marine ecosystems.

### Research Initiatives on Seagrass Beds

The status of research and development on seagrass ecosystems and resources in the Philippines has been described by Fortes (1995). The country is relatively the most advanced in terms of scientific efforts to understand seagrass ecology and environmental roles. For the other countries in the region, the small emphasis placed on their seagrass research and development activities is partly a function of the following interrelated factors: (1) localized abundance of seagrass habitats associated with the length and nature of the coastline; (2) available expertise; and (3) current state of knowledge on the ecosystem. The archipelagic nature of the Philippines has endowed the country with a high diversity of seagrass habitats.

Expertise in seagrass research and knowledge on the ecosystem in Southeast Asia is quite limited. This is reflected in the number of publications which total only 193 for the period 1983-1995. Of the publications, 97 are products of activities outside the ASEAN-Australia Living Coastal Resources Project, while 96 resulted directly or indirectly from the activities of its seagrass component. Of the total, 80 percent came out only from 1986 when the project was initiated.

Current research activities in seagrass ecosystems in the Philippines and in Southeast Asia fall under five categories: seagrass structure, dynamics, fisheries, environmental factors, and applied aspects. Among the member countries, these activities are largely concentrated on the structural aspects of species composition and distribution and their associated fisheries (finfishes and invertebrates), indicating, among others, the relative novelty of the subject. With the exception of the Philippines, much less research interest has been invested by the countries on the dynamic aspects of seagrass ecology. This is one reason why the roles of seagrasses are as yet with limited applications in addressing environmental issues in the region.

Among ASEAN countries, and only in the last five years, the Philippines has advanced substantially in understanding the basic biology, trophic dynamics, and broad-scale distribution of its seagrass resources. From the data, it has initiated a program of research that investigates the role of seagrasses in protected areas, their usefulness in the rehabilitation of degraded coasts, and in monitoring impacts from environmental stresses imposed by industrial activities.

### Research Initiatives on Coral Reefs

In the past two decades, coral reef research in the Philippines has taken virtually a quantum leap from what was almost purely taxonomic work to a breadth and quality at present which is almost at par with that in the most advanced scientific institutions (Gomez et al., 1994). The initial projects in the mid-70s enabled local scientists to design and test various reef monitoring techniques. Contributions have been made to international literature on suitable field techniques for detecting changes in coral reef structure (Gomez and Alcala, 1984; Gomez and Yap, 1984, 1986). In the course of time and further improvement of community structure methods, particular methodologies have been standardized and adopted for use on a broader geographic scale, e.g., Southeast Asia. A new generation of studies using these techniques has shed much light on the broad distributional patterns of reefs and their associated assemblages, such as fish, in the Philippines (Gomez et al., 1989; Hilomen and Gomez, 1989; Licuanan and Gomez, 1989). Research into the dynamics of these ecosystems initially concerned the nature of their recovery from physical damage, the most notable being blast fishing (Alcala and Gomez, 1979; Aliño et al., 1985; Yap and Gomez, 1989). Emphasis was given to this aspect

because of its important economic as well as ecological implications. Coral growth and energy dynamics were the focus of the work of Yap et al. (1990).

A crucial parallel study focused on studies on coral growth, both on natural as well as artificial substrates (Alcala and Gomez, 1979; Alcala et al., 1981, 1982; Yap and Gomez, 1981; Yap and Gomez, 1984, 1985a; Gomez et al., 1985a; Yap et al., 1990). Many of these studies involved the use of coral transplantation as a tool for studying physiological responses of the organisms. Another goal of coral transplantation is with respect to the rehabilitation of damaged habitats.

Initiatives on the Species of Special Concern

The following is a timeline of events relating to the conservation of the dugong:

1. 1977-1979 - Surveys and capture operations in the country conducted jointly by Japanese and Filipino scientists;
2. Mid-1980s - NGOs and Silliman University Marine Laboratory conducted surveys and information campaigns; Toba Aquarium in Japan and Pawikan Conservation Program (PCP) embarked on a research and capture operations in Bacuit Bay; the dugong captured in El Nido is now being kept alive in Toba Aquarium as a part of their scientific studies;
3. 1991 - DENR issued Administrative Order No. 55 making the dugong the first marine mammal to be protected by law in the Philippines;
4. 1992 - With the help of Toba Aquarium, PCP launched a massive information campaign in the whole province of Palawan;
5. 1993 - three fishermen were convicted of seining and killing dugongs in Taytay, Palawan; they were fined P500 for the offense.

### 3.2.4 Conservation of Agricultural Ecosystems

Opportunities

1. Predominance of Traditional Farmers

   Majority of the farmers in the Philippines are on subsistence farming. Their farming systems are characterized by planting of several crops in one small area. These systems also vary in combination with the change in season.

2. Increasing Role of NGOs and the Increasing Awareness of the Participatory Approach in Rural Development

   The participatory approach in the disposition of farm technologies and farm planning has been a key strategy in the country.

3. Increasing Awareness on the Role of the Environment in Rural Development
   There is no doubt that environmental awareness is one of the major changes that has gained acceptance.

4. Domesticated Exotic Species Diversity Conservation

   Availability of genetic materials in many parts of the country is a growing concern among some government agencies. Recently, the DA, PCARRD and some agricultural colleges and universities met concerning animal genetic resources conservation, management, and utilization.

### 3.2.5 Conservation of Protected Areas

The implementation of the NIPAS law has generated a lot of projects and activities with funding from international and local sources. These include the following: (1) Conservation of Priority Protected Areas Project (CPPAP) funded by the World Bank's Global Environment Facility; (2) the National Intergrated Protected Areas Project funded by the European Union (EU-NIPAP), (3) Technical Assistance for Biodiversity Conservation and Buffer Zone Establishment funded by the Asian Development Bank; (4) Biodiversity Assistance to CPPAP funded by the Danish Government and World Bank; (5) Dutch assistance for the NIPAS law implementation; and (6) local assistance in the implementation of NIPAS law.

The CPPAP is pilot testing the NIPAS law in the first ten priority sites identified in the IPAS Final Report (1992). It is a collaborative effort between the DENR and the NIPA, Inc. (a consortium of 18 local NGOs engaged in development, environment, and social preparation activities) designed to involve local organizations in the implementation of the project. The project has four major components: (a) site development, (b) resource management,

(c) socio-economic management, and (d) technical assistance, monitoring, and coordination. It is in the initial stages of implementation.

The EU-NIPAP approximates the design of the CPPAP as it will also implement the NIPAS law. The major difference between the two projects is in the project management, where a European Co-Project Director and a local Project Director will handle the former whereas a national host NGO is involved in the latter. Both project directors will have full authority to decide on the financial and operational matter, provided that the National Program and Policy Steering Committee (NPPSC) initially approves the Annual Work and Financial Plan. This project is in the initial stages of implementation.

The ADB technical assistance for biodiversity conservation and buffer zone establishment will pilot test the buffer zone policy developed by the DENR-PAWB. This assistance will also support information, education, and training activity for DENR field staff and PAMB members on the various aspects of PA management, including the transfer of capability to other PA staff outside of the project sites. The Mt. Iglit-Baco National Park and the Bicol National Park were the proposed pilot sites for the project in 1995.

The Danish-World Bank biodiversity assistance project to CPPAP involves the development of a biodiversity monitoring and evaluation system, biodiversity capability building, advocacy and other related activities in the terrestrial, marine and wetland ecosystems in three CPPAP sites. Commissioned by the Danish Government is NORDECO, a Denmark-based consultancy firm to coordinate with NIPA, Inc. and PAWB.

The Dutch assistance for the implementation of the NIPAS law takes charge of two sites: the El Nido Marine Park and the Palanan Wilderness.

Many NGOs are probably not aware that their projects, directly or indirectly, contribute in the conservation of biodiversity of protected areas, thus these are neither officially recorded nor reflected in the government report on PA management. Several locally funded projects directly concerned with biodiversity conservation are being implemented and a number of others are being negotiated (Tables 82 and 83). A partial list of national and local NGOs directly engaged in conservation work in protected areas are listed in Tables 84 and 85. The emergence in the NGO community of a conscious effort towards

***Table 82*** *Locally funded projects on biodiversity conservation in protected areas, partial list*

1. Mt. Kitanglad Community-Based Habitat Management Project
   Protection of habitats of the Philippine Eagle by organizing and assisting communities critical in its conservation in Mt. Kitanglad.
2. Mt. Pulog National Park Project
   Institutionalization of the PAMB, management planning, research studies, PA protection and maintenance, visitor management, community organizing, IEC and general administration.
3. El Nido Marine Reserve Management
   Protected area resource management.
4. Tubbataha Reefs Marine Park Conservation
   Resource management and protection, research, survey and investigation, IEC, and community development in Cagayancillo.
5. Conservation of Mt. Banahaw National Park
   Community-based biodiversity protection and conservation through training, research, documentation and education. Residents of several political units are targets for education and local community organizing.
6. Conservation of Mt. Malindang National Park
   Community development, boundary delineation, buffer zone identification and management, IEC.
7. Lake Bulusan Conservation Planning Project
   Assessment of the conditions of endemic and endangered species of both flora and fauna, deeper investigation of the sources of ecological threat and destruction, boundary delineation, increase in ecological-environmental awareness of the communities surrounding the area, development of the management capabilities of POs, NGOs, and GOs, particularly the PAMB.
8. Conservation and Development of Mt. Matutum
   Biological resource assessment, socio-economic survey and profiling, inventory of existing development plans and projects, community organizing, resource and management planning.
9. Bicol National Park Conservation
   Community-based park protection, institution building (internal organizational capability and linkage building), survey of additional forested sites, community organizing and livelihood assistance, traditional forest protection, research and planning.

***Table 83*** *Local NGOs' Foundation for the Philippine Environment (FPE) supported projects in protected areas (Exchange rate of P25:$ 1).*

| NGO | FUNDING AGENCY | NATURE OF SUPPORT | AMOUNT (proposed) $ | DURATION | SITE |
|---|---|---|---|---|---|
| 1. Phil. Eagle Foundation, Inc. | FPE | Grant | 456,080.00* (811,164.00)** | 3 years, ongoing | Mt. Kitanglad, Bukidnon |
| 2. Phil. Business for Social Progress | -do- | -do- | 84,460.52 | 1 year, ongoing | Mt. Pulag, CAR |
| 3. Marine Turtle Fnd., Inc. | -do- | -do- | 64,535.60 (70,935.60) | 1 year, ongoing | El Nido Marine Reserve, Palawan |
| 4. Tubbataha Foundation | -do- | -do- | 79,680.00 (145,160.00) | 2 years, ongoing | Tubbataha Reef National Marine Park, Palawan |
| 5. Luntiang Alyansa ng Bundok Banahaw | -do- | -do- | 79,920.00 (146,086.40)* | 1 year, ongoing, preparatory phase | Mt. Banahaw, Quezon |
| 6. Pipuli Fnd. Inc, et al. | | | 39,316.78 48,866.58 | 10 months preparatory phase | Mt. Malindang, Misamis Oriental |
| 7. Likas, Inc. | -do- | -do- | 42,422.96 (56,062.01) | 1 year, ongoing, preparatory phase | Mt. Lake Bulusan N.P, Sorsogon |
| 8. Mahintana Foundation Inc., et al. | | | 54,312.00 (69,272.00) | 1 year, ongoing, preparatory phase | Mt. Matutum, South Cotabato and Sarangani Province |
| 9. Bicol NP Foundation | -do- | -do- | 48,266.00 (169,058.80) | 1 year, ongoing | Bicol National Park, Camarines Sur |

* *Only the FPE subsidy*
** *Total project cost*

Source: FPE

***Table 84*** *National and local NGOs involved in the implementation of the NIPAS law, partial list*

| |
|---|
| Bataan NGO Consortuim (BNC) (Host NGO of CPPAP for Bataan National Park) |
| Batanes Development Foundation, Inc. (Host NGO of CPPAP for Batanes) |
| Foundation for Sustainable Development, Inc. (undertaking the WWF NIPAS Training Program at the Subic Training Center) |
| Karaga Biodiversity Linkages (KABILIN) (Host NGO of CPPAP for Agusan Marsh) |
| Kitanglad Integrated NGO (KIN) (Host NGO of CPPAP for Mt. Kitanglad) |
| Multi-Sectoral Alliance for Development in Negros (MUAD) (Host NGO of CPPAP for Mt. Canlaon) |
| NIPA Inc. (NGOs for Integrated Protected Areas, Inc.) (National NGO undertaking (CPPAP) |
| Philippine Ecumenical Action for Community Empowerment Foundation, Inc. (PEACE) (Host NGO of CPPAP for Apo Reef) |

***Table 85*** *NGO members of NIPA, Inc.*

| |
|---|
| Association of Foundations (AF) |
| Center for Alternative Development Initiatives (CADI) |
| Community Extension and Research for Development (CERD) |
| Convergence for Community Centered Area Development |
| Cooperative Foundation of the Philippines, Inc. (CFPI) |
| Earth Savers Philippines, Inc. |
| Green Forum-Philippines, Inc. |
| Haribon Foundation for the Conservation of Natural Resources |
| Mindanao Environment Forum |
| Nature Crusaders of the Philippines Foundation |
| Philippine Business for Social Progress (PBSP) |
| Philippine Federation for Environmental Concern (PFEC) |
| Philippine Institute of Alternative Futures (PIAF) |
| Philippine Rural Reconstruction Movement (PRRM) |
| South East Asian Institute of Culture and Environment (SEAICE) |
| Tambuyog Development Center |
| Tribal Communities Association of the Philippines (TRICAP) |
| Women's Action Network for Development (WAND) |

biodiversity conservation is critical in ensuring the successful implementation of the NIPAS law.

## 3.3 National Legislation and International Agreements

National policies and international agreements may have formulative impacts on biodiversity by defining the scope of utilization of biological resources. Policies and laws influence the behavior of resource users and hence, the status of biological resources. Moreover, policies may have cross-sectoral impacts, i.e., macroeconomic policies may impact directly or indirectly on the resource extraction sectors. This section summarizes and assesses relevant national legislation and policies as well as international agreements and conventions with their impacts on biological diversity.

### 3.3.1 National Legislation and Policies

A suitable starting point is the Philippine Constitution which indirectly espouses the goals of the Convention of Biological Diversity. First, conservation of nature is pursued through "a balanced and healthy ecology in accord with the rhythm and harmony of nature." More specifically, the delineation of forest lands and national parks is required of Congress and "thereafter, such forest lands and national parks shall be conserved and may not be decreased nor diminished," and Congress is to "determine measures to prohibit logging in endangered forests and watershed areas." Second, equitable use of natural resources is pursued with the recognition and promotion of "the rights of indigenous cultural communities within the framework of unity and national development" and protection of the "rights of subsistence fishermen, especially local communities, to the preferential use of communal marine and fishing resources, both inland and offshore." Preference is also given to Filipino citizens and corporations with major ownership by Filipinos in the exploration, development, and utilization of natural resources and in the ownership of alienable lands. Third, the sustainable use of natural resources is implied in the provisions on the conservation of natural resources. The Constitution mandates the pursuance of the twin goals of economic development and of the preservation and protection of our natural and indigenous resources.

Against this basic policy declaration, the current economic and non-economic policy framework that has been instituted by the government to achieve its objective of becoming one of the newly industrializing countries at the turn of the century were assessed. The growing concern for the environment and the judicious utilization of our natural wealth to attain economic development also resulted in the enactment of a number of policies advocating the protection of the country's natural resource base. Specific policies and legislation are reviewed below.

#### Recent Landmark National Legislation and Policies

The following group of policies and laws directly impact on biological diversity:

Executive Order 192 (series of 1987)

EO 192 created the Protected Areas and Wildlife Bureau (PAWB) which is mandated to consolidate all government efforts in the conservation of natural biological resources through the establishment of a network of protected areas system. PAWB was responsible for the passage of the NIPAS Law (Republic Act 7586 of 1992).

Republic Act 7586 of 1992

The most important piece of legislation in maintaining biodiversity is RA 7586 otherwise known as the NIPAS law which provides for the establishment and management of the National Integrated Protected Areas System. Considered ambitious, it espouses the twin objectives of biodiversity conservation and sustainable development against a backdrop of rapid loss of forest cover and other critical areas, lack of political will and social concern for parks conservation, and series of changes in the administration of national parks since the 1950s.

The specific provisions of the NIPAS are: (a) creation of Protected Area Management Board; (b) identification of protected area categories; (c) establishment of standard planning process; (d) NIPAS administration by DENR; (e) establishment of a trust fund for NIPAS; (f ) recognition of ancestral rights; and (g) institutionalization of environmental impact assessment.

Community sustainability is a policy of the NIPAS law with the concern for the development of the socioeconomic and political fibers of the communities that directly use the resources. The habitat management approach highlights the involvement of people in the management of protected areas with the recognition of indigenous

cultural communities and tenured migrant communities. The latter refers to communities within protected areas which have actually and continuously occupied such areas for five years prior to designation of the same as a protected area. As of this year, the NIPAS law is being implemented in nine sites with funding from the Foundation for Philippine Environment and in 10 sites with foreign funding. Additional 15 sites with foreign funding are on the pipeline.

Executive Order 247 (series of 1995)

EO 247 prescribes the guidelines and establishes a regulatory framework for the prospecting of biological and genetic resources, their by-products and derivatives for scientific and commercial purposes and for other purposes. This EO supports provisions of the Convention on Biological Diversity to which the country is a contracting party. The framework ensures that in the prospecting of biological and genetic resources these resources are protected and conserved, developed and put to sustainable use for the benefit of national interest. Prospecting in ancestral lands and domains may be done only with prior informed consent of indigenous cultural communities. An inter-agency committee is formed as a regulatory body to ensure that the provision of the EO are enforced and implemented.

Bioprospecting activities and projects require Academic or commercial research agreement between the government and the person, entity or corporation undertaking such activities/project. Limits on the quantity of samples that a commercial or academic entity can collect are set. Likewise, the collector is required to deposit with the National Museum, a complete set of specimens collected. More importantly, agreements should include a provision for the payment of royalties to the National Government, local or indigenous community and individual person or designated beneficiary in case commercial use is derived from the biological and genetic resources taken.

## Legislation and Policies Affecting Forest Ecosystems

The preservation of forest resources is synonymous with the preservation of biodiversity. The Forestry Code, PD 705, remains the primary legal instrument guiding the utilization and conservation of forest resources in the country. Legal issuances cover the protection of specific areas with rich forest resources. These include RA 7611 (1991) declaring a Strategic Environmental Plan (SEP) for Palawan for the conservation, utilization, and development of natural resources to provide optimum yield on a continuing basis. Subsequently, AO 45 (1992) declared a moratorium on all commercial logging in Palawan. Another conservation-oriented legal issuance is Proclamation No. 926 establishing the Subic Watershed Forest Reserve. Likewise, large tracts of mangrove areas all over the country have also been declared wilderness areas thus limiting access to and extraction of mangrove forest resources. AO 24 (series of 1991) prohibits logging from old growth or virgin forests and declares these areas as part of the integrated protected areas system. This augurs well for biodiversity as a tropical forest is one of the most ecologically diverse ecosystems.

Various administrative orders (AO 247) were issued regulating the use of all types of forest resources, e.g., old-growth forests, secondary forests, mossy forests, mangroves, through command and control instruments and through penalties for violations of the law. The involvement of communities, both indigenous and upland migrant communities, in the management of forest resources is actively sought in, for example, reforestation of dipterocarp and mangrove forests. It is probably in forestry projects that direct resource users have become resource managers.

## Legislation and Policies Affecting Wetland Ecosystems

Policies and legal instruments covering wetland ecosystems included in this review pertain to lakes, rivers and intertidal areas and freshwater resources therein. Administrative orders, some dating back to 1935, call for the conservation of certain species, e.g., dalag, kanduli, and banak, and the regulation of the exportation of mud crabs and eel fry and fingerlings and importation of live shrimp and prawns. The conservation and protection of fishery resources in major freshwater lakes like Laguna de Bay, Taal, Buhi, Bato, etc., has been addressed by the establishment of sanctuaries within the lake areas.

## Legislation and Policies Affecting Marine Ecosystems

The tropical waters of the country are among the most ecologically diverse marine ecosystems in the world and laws have been enacted for the sustainable use of and protection of marine organisms and

habitats. Related laws and policies address fishing and fisheries, mangroves, coral reefs, seaweeds, invertebrates, marine pollution, national parks and wildlife, and water quality management. PD 704 or the Fisheries Decree, as amended, remains the primary law governing the utilization of all fishery resources. Various fishery administrative orders were issued covering the following, among others: *prohibiting or regulating the capture of endangered* marine species, e.g., marine turtle or pawikan, sea cow or dugong, prohibiting the use of destructive gears like muro-ami and kayakas, prohibiting the use of commercial trawl and purse seine in municipal waters, regulating the use of fine-mesh nets, declaring marine sanctuaries, regulating the farming of seaweed in coral reefs.

### Legislation and Policies Affecting Agriculture

Agrobiodiversity in the country is regulated by several legal issuances specifying guidelines on the introduction of certain species of animals such as horses, porcine, cattle, gamefowls etc. (various Department of Agriculture Administrative Orders) and plants (Presidential Decree 1433). Likewise, the export of indigenous crop and animal species has been controlled to maintain the comparative advantage of the country in these species (e.g., Administrative Order 14, series of 1987 on ramie).

There are a number of relevant pieces of legislation. First is Republic Act 7308 or the Seed Industry Development Act of 1992 which promotes and accelerates the development of the seed industry and mandates the conservation, preservation and development of plant genetic resources of the nation. It vests upon the University of the Philippines Los Baños the leadership in plant biotechnology activities related to plant improvement, genetic resources conservation and in vitro mass production of planting materials. Second is Republic Act 7900 or the High-Value Crops Development Act of 1995. This provides for the development of high-value crops as export crops to augment foreign exchange earnings of the country through the establishment of experimental stations and seed farms for the development of varieties suitable in the various agro-climatic areas of the country.

### State Policies on Land and Indigenous Cultural Communities/ Indigenous Peoples

Indigenous peoples and lowland farmers who have practiced traditional multicrop agriculture have contributed, by and large, to the conservation of biological diversity. Unfortunately, several state policies with their roots in the colonial past have severely undermined this capability. Recent legislations and international agreements have tried to address this problem but are either weak or ambiguous.

*At the very foundation of state laws and subsequent* policies on land and ICCs/IPs is the Regalian doctrine. Strictly, the Regalian doctrine is not a legislative issuance and is even regarded as "legal fiction." As a doctrine it has its roots in Spanish colonialism; by reason of conquest, all lands in the archipelago that became the Philippine nation state became the property of the Spanish Crown. This doctrine was carried forward by the American colonizers and later embodied in a number of Philippine laws and the different Philippine Constitutions, including the latest, the 1987 Philippine Constitution. Adherence to the Regalian doctrine has prevented the indigenous peoples from claiming private communal rights to their traditional territories, now known in the 1987 Philippine Constitution (Section 5, Article XII) as ancestral domain and in the case of the Cordillera peoples of Northern Luzon and the Muslims of Mindanao, as Autonomous Region (Article X). This has undermined the capability of indigenous peoples to continue practicing their institutions and their concomitant belief and knowledge systems. One effect of this has been the reduction of biodiversity and cultural diversity as well.

But some changes in the legal framework are taking place and more people are joining the struggle against the inflexibility of the Regalian doctrine. But mere recognition by the State of indigenous peoples' rights to their ancestral domains does not guarantee the conservation of biodiversity. Because of the intensifying exposure of indigenous peoples to the various forces and agents of environmentally sustainable economic growth, the indigenous peoples themselves have to be able to improve upon their already sustainable resource management inputs from outside. They need to strengthen their organizational capability to deal with the numerous threats to their land and to biodiversity which have hitherto nourished the integrity of their diverse culture.

As a supporting policy, the provisions on ancestral lands and domains in the 1987 Philippine Constitution as well as some jurisprudence could be interpreted liberally in full support of the rights

of indigenous peoples. After all, the benefits from such State recognition would redound not only to the indigenous peoples but also to everyone who stand to benefit from well-conserved biodiversity. And that means the present generation as well as those yet to come.

Other provisions of the 1987 Philippine Constitution relevant to ICCs/IPs are: (1) Section 22, Article II. The State recognizes and promotes the rights of indigenous cultural communities within the framework of national unity and development; (2) Section 5, Article XII. The State, subject to the provisions of the Constitution and national development policies and programs, shall protect the rights of indigenous cultural communities to their ancestral lands to ensure their economic, social, and natural well-being. Congress may provide for the applicability of customary laws governing property rights or relations in developing the ownership and extent of ancestral domain.

These Constitutional provisions are meant to support the struggles of indigenous peoples for their right to self-determination, i.e., their right to take control of the direction of their development as distinct cultural communities, or as peoples. They have the potential of protecting the rights of the ICCs or IPs to their traditional territories or ancestral domains and with this, their traditional resource management practices which have hitherto contributed to the protection of biodiversity-rich areas. Unfortunately, the legislature has not yet enacted the enabling laws to fully implement the Constitutional mandate. Meanwhile, pending the enactment of appropriate legislation, the executive department, through the DENR, by virtue of DAO No. 2, series of 1993, is now undertaking identification and delineation of ancestral domains being claimed by a growing number of ICCs/IPs.

### Industrialization, Trade, and Investment Policies

Economic policies that pursue the goals of the present administration of NIChood by the year 2000 are included and reviewed. The broad targets of Philippines 2000 include sustained and broad-based growth in output and employment, reduction in poverty incidence, price stability and global competitiveness. Its major policy objective includes an export-led growth and a balanced regional development stirred by the active participation of the private sector. In the light of the positive impact of current policies, a subsequent question pertains to the "costs," if any, of achieving the goals of economic growth and development. Thus, the other objective of this assessment includes determining whether or not the pursuit of economic growth and development puts safeguards on the preservation of the environment, natural resources, and other natural assets, including biodiversity.

The first set of policies is geared to fuel export growth. These are: Special Economic Zone Act of 1995 which initially identified 39 provinces as ecozones; Bases Conversion and Development Act of 1992 which provides guidelines in the conversion of Subic Bay into a freeport and special economic zone, EO 226 or the Investment Priorities Plan (IPP); RA 7844 or the Export Development Act of 1994; RA 7042 or the Foreign Investments Act of 1991 and RA 7662 or the Foreign Investors' Lease Act. The general policy puts a premium in supporting private sector initiatives.

At present, priority investment areas under the IPP include both agricultural and non-agricultural based industries. Among these are projects in crop and aquaculture production; establishment and expansion of cement factories; exploration and development of mineral resources, mining, quarrying, and processing of metallic and non-metallic minerals, power generation projects utilizing non-conventional energy sources such as hydroelectric power, geothermal power, biomass and other agri-based residues, tourism projects; production of indigenous herbal medicines, and environmental and conservation projects that cover forest plantation farms and integrated waste management to service domestic industries. It appears that such an incentive structure that essentially provides subsidies to priority investment areas exposes these industries to potential exploitation and possible destruction of natural habitats if no environmental safeguards are in place. Fortunately, the IPP contains a provision that requires compliance with existing environmental and pollution standards for projects critical to the environment in general. However, it must be stressed that problems of enforcement and the period within which the government allows businesses to avail of these incentives are pressing problems that need assessment. Another potential consequence, given the incentive structure, is that small marginal producers may be eased out of the market as competition becomes keen. Consequently, this could take a toll on the country's resource base as large-scale producers with adequate capital and access to technology capture the bigger slice of the market.

With the conclusion of the Uruguay Round on April 15, 1994, the results of the discussion under the

General Agreements on Trade and Tariffs (GATT) was enforced starting January 1, 1995. For the Philippines, in particular, amendments to the Tariff and Customs Code and Investments Code have been worked out. Under the Uruguay Round discussions and the GATT, the Philippines, together with other member countries has committed itself to remove all existing quantitative restrictions on agriculture, textiles/clothing and other commodities over a period of 10 years. It also committed itself to bind or maintain tariffs on specific agricultural products and services and gradually remove subsidies on agriculture. With this trade regime, further liberalization of trade laws is expected in the long-term as GATT espouses global free trade. This is in addition to the basic structural reforms in trade that have already been carried out by the country such as the promotion of a more liberal trade framework and tariff reforms that eliminate quantitative restrictions, ensure freer entry of imported inputs used by the export sector, promote a wider range of export products and maintain a flexible exchange rate.

The rationalization of the tariff structure with the eventual lowering of tariff on raw materials to three percent by the turn of the century and the phasing out of subsidies will have strong consequences on resource extraction industries. In the long-term, these policies will force the industry to be more competitive and thus be more efficient with the correction of bias towards widescale extraction of resources which had been encouraged by tariff protection and subsidies. More importantly, this will eventually phase-out the remaining subsidy structure in natural resource based industries upon full implementation of major provisions under the trade agreement. The Uruguay round of discussions, however, excluded rules governing the linkage between trade and the preservation of the environment, which prove difficult to tackle. A working party to look into this issue was created with the assurance of the trade body that this will be included in its future agenda. In the meantime, this does not forebode well for member countries that will be faced by this very real issue.

Overall, the sensitivity of the country's monetary and financial reforms to market forces present positive developments for the entire economy. However, some would argue that these still fall short of rationalizing investment decisions with the remaining distortions in the domestic capital markets. Nonetheless, the market-determined cost of capital, (i.e., market interest rate), forces careful assessment of investment opportunities and plans particularly in long term resource extraction industries which in the past depended on highly subsidized capital for growth.

Current policies also contain provisions on the non-economic aspects including the environment. For instance, RA 7916 (Special Economic Zone Act of 1994) is an improvement over PD 66 (Export Processing Zone Authority Act). Legislated to address one of the policy objectives of the government to promote a balanced regional development, both define the incentives and procedures in the operation of enterprises within the designated zones. However, the latter is silent on the environmental aspects of development. In contrast, RA 7916 contains a specific provision on the protection of the environment in the designated ecozones. Specifically, RA 7227 or the Bases Conversion and Development Act, adopts the country's existing environmental protection and conservation laws while at the same time introduces a system of environmental regulations consistent with DENR policies. Similarly, other laws such as the Omnibus Investment Code and the Build-Operate-Transfer Law require compliance with specific environmental standards acceptable to existing environmental laws and waste management prior to project approval.

### Other Policies

#### RA 7160: Local Government Code

Under the existing Local Government Code, LGUs are given the authority to exercise their power in managing the country's resources. LGUs can reclassify agricultural lands and provide for the manner of their utilization and disposition. Moreover, the national government is also required to consult with LGUs to regulate the implementation of projects that could cause pollution, climatic change, depletion of non-renewable resources, loss of crop land, rangeland or forest cover and the extraction of animal or plant species. The implementation of community based forestry projects and the enforcement of fishery laws also falls under the authority of LGUs. The Local Government Code allows LGUs to collect taxes on businesses, fees and charges on fishery privileges granted, mining taxes, royalties, forestry and fishery charges in the utilization and development of these resources within their area. Financial support and credit facilities can also be availed of to aid in the implementation of these projects. Support to the agricultural sector through the distribution of planting materials, provision of agricultural extension

and on-site research services and facilities, enforcement of fishery laws in municipal waters including the conservation of mangroves are other powers devolved to the LGUs. Such provisions vest in the LGUs the power to reject or approve the implementation of projects and put on their shoulders the burden of balancing their decision to uplift their communities' economic status and at the same time conserve the resources under their jurisdiction.

The Local Government Code, however, provides preferential treatment and protection for the marginalized sectors such as the fishery, community-based forestry and other agriculture-related projects by providing extension services and research facilities. Provincial governments, in particular, are required to enforce forestry laws on community-based forestry projects, pollution control law, small-scale mining law and other laws on the protection of the environment and mini-hydroelectric projects for local purposes.

RA 6657: Comprehensive Agrarian Reform Law

At the heart of the designation of special economic zones is the existing law on land use conversion or Administrative Order (AO) No. 1. The law is supposed to implement the broad legal mandate covering three major laws that include the Comprehensive Agrarian Reform Program (CARP) as contained under RA 6657, the mechanism for the implementation of the CARP under EO 229, and the institutional strengthening of the Department of Agrarian Reform (DAR). However, existing regulations on the conversion of agricultural lands to non-agricultural uses have a number of shortcomings. Moreover, a very specific amendment to the CARP covers the conversion of public and private agricultural lands into fishponds and prawn farms. While the building of new fishpond areas may be necessary to augment dwindling production from capture fisheries, there are foregone benefits or costs of conversion. This adds to the concerns on the negative impact of CARP.

The conversion of agricultural lands, which increased tremendously in the last five years, was due to the competing demands for the use of available lands. On top of the CARP, it has been argued that the existing land use conversion policy threatens our food self-sufficiency and environmental quality. There may be no conflict in the country's pursuit of agricultural and industrial development except that most of the productive agricultural lands covered by CARP are the same areas identified as suitable for industrial or urban usage. The provisions of the Local Government Code (RA 7160) authorizes local government units (LGUs) to prepare comprehensive land plans enacted through zoning ordinances. Such plans shall be the primary and dominant bases for future use of land resources and their preparation should consider requirements for food production, human settlements and industrial expansion. Nonetheless, despite the autonomy accorded to LGUs in this regard, the lack or absence of a national land use policy that defines the framework for the efficient utilization of available lands considering national priorities as food production and the environment may constrain them in their preparation of a rational framework of land utilization in their area of jurisdiction. To date, the general framework and implementing guidelines of the National Land Use Code has not been legislated although a draft proposal has been prepared by the National Economic Development Authority (NEDA). Until such time that this piece of legislation is passed, present policies on land conversion offer no rational basis for the determination of the optimal utilization of our available lands.

The existing policies on land use or conversion preclude productivity and environmental considerations which negatively impact on the conditions of our resource base and the environment in general. The enactment of a national land use code to rationalize the rapid pace of land development in the country needs to be expedited. Once this is legislated, another step that should be undertaken is for the government, particularly those tasked to implement the law, to take a strong resolve to implement the provisions of the law. With the inclusion of environmental protection provisions in most of the policies that promote trade and investments, there must be a strong commitment for implementation not only on paper but also when faced with issues on trade that are linked to the environment. The importance of this commitment can never be overemphasized as this has direct effects on the future of our scarce and depletable resources, specifically their continued availability and productivity. Their maintenance and preservation provide one of the major factors in attracting investments in the country.

### 3.3.2 Assessment of National Legislation and Policies

The preceding review of national policies and legislation tended to focus on those with impact on

natural resources and the environment. Such focus is borne by the fact that legislation pertaining explicitly on biological diversity are few and fairly recent to evaluate and assess. The premise of the review therefore is that policies that rationalize the use of biological resources would be beneficial to biodiversity. The salient features of the reviewed national policies and legislation are enumerated below.

Previous policies (albeit, not included in this review) as well as some current policies have encouraged entry into the natural resources industry. Development, the objective in almost all natural resources sectors, was pursued through the granting of tax and non-tax incentives which served to accelerate degradation of the natural resource base. Subsequent policies should have shifted away from development to management of biological resources.

The focus on conservation and protection in some of the existing policies and legislation is appropriate considering the overexploited and degraded natural resources of the country. It should be emphasized, however, that these may not yield the desired results unless policies in other sectors are aligned accordingly. This is discussed further in the succeeding observations.

The interdependence and consistency of policies needs to be addressed. For instance, in the area of macroeconomic policies, vestiges of subsidies to specific industries like agriculture and resource-based industries still remain under the current incentive structure. These will have long-term effects on our resources if such strategies are continued.

The utilization of the country's wealth may be over-regulated considering the plethora of legal issuances covering the various ecosystems. Nonetheless, there is continuing degradation of the environment and natural resources although there are a few bright spots.

The previous observation may be attributed to the lack of machinery and political will in enforcing laws. There are negligible penalties for violation and inadequate machinery for prosecuting violators, among others. These aspects need strengthening.

Unregulated access to common pool resources such as forests and fisheries contributed to their degradation. The shift from centralized to decentralized management of resources is a positive development in this aspect. The greater involvement of communities in the management or enhancement of upland and coastal natural resources is envisioned to rationalize the use of these resources.

Current policies on industrialization, trade, and investment have put safeguards on the protection of the environment. Conspicuously absent though is a national land use policy which is most pressing considering the resurgence of the Philippine economy.

Macroeconomic policies, in particular, monetary policies have tended to follow market forces, hence, undervaluation of capital inputs is minimized. Such orientation may encourage more rational use of other inputs in production including the environment and natural resources, and hence, biodiversity.

There is a need to codify and update all laws relating to various resource extraction and environment sectors. The pursuit of sustainable development and management should be a vital component for all sectors of the economy particularly in resource extraction industries.

### 3.3.3 International Agreements

In general, international agreements on biodiversity conservation recognize the sovereign laws of each country, place importance in enhancing the biodiversity resources globally and call for the implementation of action plans for the judicious utilization of resources. The country's compliance to these international initiatives augurs well for the conservation of biodiversity in the country. Listed below are the various international agreements and conventions to which the Philippines is a signatory.

#### Convention on Biological Diversity

This global treaty seeks to conserve and enhance the biodiversity resources of the world. The urgent output to be generated is a country study on biological diversity, including a strategy and action plan to conserve biodiversity. The Philippine Senate ratified this convention in 1993.

#### Convention on Wetlands of International Importance

The Ramsar Convention in 1971 encourages the formulation of a wetlands action plan and the identification of internationally significant wetland areas. This was ratified by the country in 1994. The

concern is the conservation of wetland habitats especially as waterfowl habitats. There are 63 wetlands of international importance in the Philippines, but only one is listed in the Ramsar register of significant wetlands as the country just recently ratified this convention.

### Bonn Convention

The Bonn convention of 1979 concerns the conservation and protection of migratory species of wild animals and was ratified by the country in 1993. Parties to the convention are enjoined to prohibit the taking of animals that are covered by the Global Treaty on Migratory Species except in certain meritorious cases. It also stipulates the restoration of important habitats in order to prevent, reduce or control those factors that are likely to endanger affected species.

### Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The CITES convention attempts to prevent commercial trade in the species of plants and animals which are in danger of extinction and to control the trade in the species which might become so if their trade is allowed to continue unchecked. Difficulties are, however, encountered in the Philippines in the identification of wild specimens and monitoring of local trade of specimens. The convention, though, brought forth captive breeding and tissue culture programs as conservation and management tools in the country.

PAWB-DENR

### International Union for the Conservation of Nature and Natural Resources (IUCN)

This is an international body that monitors and assists the member country's efforts in protected areas management and establishment. The Philippines has been a member since 1962.

### Pulau Rambut Declaration

This urges all governments and relevant NGOs to stop the degradation and loss of wetlands in Southeast Asia and recommends a number of actions to be taken. Governments are urged to strengthen coordination among all sectors of society, require environmental impact assessment, monitoring and control mechanisms including the establishment of a national wetland committee to ward off degradation of watersheds from drainage and conversion, pollution, and overexploitation of resources.

### ASEAN Declaration on Heritage Parks and Reserves and Declaration on Environment

The declaration was signed in 1984 and Mt. Iglit Baco National Park and Mt. Apo National Park were named as ASEAN Heritage Parks to conserve two endangered species, the Philippine tamaraw and the Philippine eagle, respectively. The agreement strengthened the protected area status of these national parks and additional measures for their conservation were implemented such as breeding in captivity. The ASEAN Declaration on the Environment at the same time pushed for more forest protection and resources conservation measures.

### General Agreement on Tariffs and Trade (GATT)

GATT requires all member countries to adopt an intellectual property rights system under the Trade Related Aspects of Intellectual Property Rights (TRIPS) accord. The relevant provision states that: "Members may exclude from patentability: plants and animals other than microorganisms and essential biological processes for the production of plants and animals other than nonbiological and microbiological processes. However, members shall provide for the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof." This agreement provides the option to patent plant varieties or to adopt an effective special form of protection. In line with this, the Philippines has enacted or repealed

existing administrative orders, bills and other laws to comply with the Uruguay Round TRIPS Agreement. Some of the major laws relevant to this agreement are RA 7308 or the Seed Industry Development Act and RA 7900 known as the High-Value Crops Development Act. Legal adjustments on Special Project for Scavengers (SPS) related laws were also undertaken to comply with the SPS Agreement. New varieties of plants are also accorded protection under the Union for the Protection of New Varieties of Plants conceptualized during the UPOV Convention of 1978.

Other International Conventions and Agreements which indirectly affect biological diversity include the United Nations Conference on the Law of the Sea, the London Dumping Convention Montreal Protocol on Greenhouse Gases, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, among others.

## 3.4 Institutional Capacity for Biodiversity Conservation and Sustainable Use

### 3.4.1 Forest Ecosystem

#### Existing Institutions

National Government agencies, non-governmental organizations, academic institutions, and some local institutions and people's organizations are involved in various programmes and projects on forest biodiversity assessment and conservation.

The government's lead agency is the DENR which has six staff bureaus. Among these bureaus, the Forest Management Bureau (FMB) and the Protected Areas and Wildlife Bureau (PAWB) are tasked with the main responsibility of forest land use, management, reforestation and social forestry, and protected areas management. Research functions are dispensed through projects under the Ecosystem Research and Development Bureau (ERDB). The Environmental Management Bureau (EMB) does in part forest monitoring and education services.

The PNM, staffed by full-time scientists, researchers, and technicians, is tasked with collection, identification, and curation of biological specimens. With the largest depository of plant and animal collections in the Philippines, the institution can provide basic information on the forest diversity resources of the country. It also has special projects on biodiversity inventory and conservation. The newly established Biodiversity Information Center handles the tasks of biodiversity data management and information dissemination of the Botany and Zoology divisions.

The Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development, under the Department of Science and Technology (PCARRD-DOST), also conducts researches on forestry and prepares manuals and other publications on technologies on the proper management, conservation, and protection of forests.

The non-governmental organizations which grant forestry projects to other NGOs and people's organizations are Foundation for the Philippine Environment, Haribon Foundation, World Wildlife Fund-Philippines, and Philippine Business for Social Progress. These NGOs also handle public education programs on forest conservation. The Philippine Center for Plant Conservation and Wildlife Conservation Society of the Philippines, both with members from the scientific community, conduct basic research on plant and animal species conservation.

Major state and private universities around the country also actively conduct basic research on forestry. Through their respective research units, some faculty of the University of the Philippines in Los Baños and Diliman, Silliman University, Mindanao State University, Western Visayas State University, Visayas State College of Agriculture, Central Mindanao University, De La Salle University, and the University of San Carlos have been involved in various projects on forest biodiversity inventory, wildlife breeding, and forest management. Students also conduct worthy theses projects on various aspects of biodiversity.

#### Technological Facilities

Remote sensing facilities are available at the National Mapping and Resource Information Authority (NAMRIA), the central mapping and land classification agency of the DENR. The Bureau of Soils also provides soil and land use maps which can be integrated to generate forest and vegetation maps.

The centers of biotechnology research are the National Institutes of Biotechnology, University of the Philippines System, and the Department of Science and Technology.

Ex-situ conservation sites and facilities, i.e., botanical gardens, seed bank/ gene banks, and captive breeding facilities, are managed by different government research institutions, non-governmental organizations and private companies.

The botanic gardens in the country include the Makiling Botanic Garden and Quezon Land Grant Botanic Garden (both managed and financed by UPLB), Manila Zoological and Botanical Garden, and the Museum of Living Collections of Indigenous and Endemic Medicinal Plants. To date, there is yet no National Botanical Garden financed by the national government.

The ERDB-DENR maintains a rattan gene bank, bambusetum, and palmetum at different locations in the country. A gene bank of medicinal plants is also found at UP Los Baños and UP Diliman.

Captive breeding facilities are also maintained by the ERDB, PAWB, Silliman University, Philippine Eagle Conservation Center, Philippine Raptor Research and Conservation Center, Calauit Wildlife Sanctuary, and Crocodile Farming Institute. Private commercial companies include Bird International, Simian Conservation Breeding Research Center, Scientific Primates Filipinas, A.T. Virri Primate Breeding Corporation, Del Mundo Trading, Ferlite Scientific Research, Inc., Amo Farm, and Flora Farm.

Information Resources

Biodiversity information based on museum collections, literature, and other published and unpublished reports and manuscripts are continuously computerized at the PNM. Databases available are at the Museum of Natural History, University of the Philippines Los Baños, and the Rare and Endangered Plants of the Philippine Center for Plant Conservation.

The existing institutions, human resources, technological facilities and information sources are listed in Table 86.

### 3.4.2 Wetland Ecosystem

Institutional and manpower capabilities for biodiversity efforts in wetlands are currently largely concentrated in the PAWB and the ERDB of the DENR. They have undertaken some census and behavioral studies of waterfowl and other wildlife species frequenting wetlands. Fisheries components, being of commercial value, are actively studied mainly by the BFAR and its outreach stations, together with the National Freshwater Fisheries Technology Research Center (NFFTRC), National Inland Fisheries Research Center (NIFRC), National Brackish Water Aquaculture Technology Research Center (NBATRC), Fishery Biological Station Complex (FBSC), and Fish Health Laboratory.

Research on all aquatic systems are monitored, coordinated and evaluated by the PCAMRD. Capabilities for invertebrates, including insects studies are quite limited, being concentrated in the UP System (UP Diliman and UP Los Baños), San Carlos University in Cebu, and possibly in Silliman University in Negros. Floral studies, algae and

***Table 86*** *Institutions involved in forest ecosystem conservation*

**EXISTING INSTITUTIONS**

*National Institutions*
1. Forest Management Bureau, DENR
2. Environmental Management Bureau, DENR
3. Protected Areas and Wildlife Bureau, DENR
4. Ecosystems Research and Development Bureau, DENR
5. Philippine National Museum, DECS
6. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development Library
7. International Institute of Rural Reconstruction

*Non-Governmental Organizations*
1. Foundation for the Philippine Environment
2. Haribon Foundation
3. World Wildlife Fund-Philippines
4. Philippine Business for Social Progress
5. Philippine Center for Plant Conservation
6. Philippine Sustainable Development Network Foundation, Inc.
7. South East Asia Regional Institute for Community Education
8. Wildlife Conservation Society of the Philippines, Inc.

*Academic Institutions*
1. University of the Philippines, Diliman
2. University of the Philippines, Los Baños
3. Silliman University
4. Mindanao State University
5. Western Visayas State University-College of Agriculture and Forestry
6. Visayas State College of Agriculture
7. Central Mindanao University
8. University of San Carlos

*Cont'n.* ***Table 86***

*Some Local Institutions and People's Organizations*
1. Provincial, City and Municipal Governments
2. Nagkakaisang Tribu ng Palawan (Natripal)
3. Tribal Community Association of the Philippines (Tricap)

**HUMAN RESOURCES**

*Expertise on Natural and Physical Science*
1. Taxonomists
2. Foresters
3. Ecologists
4. Zoologists
5. Geneticists
6. Ethnobotanists
7. Biogeographers
8. Anthropologists
9. Wildlife biologists
10. Dendrologists
11. Forest entomologists
12. Forest pathologists
13. Forest surveyors

**TECHNOLOGICAL FACILITIES**

*Remote Sensing*
1. National Mapping and Resource Information Authority, DENR
2. Bureau of Soils, DA
3. College of Engineering, UP Diliman

*Biotechnology*
1. National Institutes of Biotechnology, University of the Philippines System
2. Institute of Plant Breeding, University of the Philippines Los Baños

*Ex-situ collection*
1. Makiling Botanic Gardens, University of the Philippines Los Baños
2. UP Quezon Land Grant Botanic Garden
3. Manila Zoological and Botanical Garden
4. The Living Museum of Philippine Medicinal Plants, managed by the Philippine Alternative Futures, Inc., Quezon Memorial Circle, Diliman, Quezon City.

*Seed Bank/Gene Bank*
1. Rattan Gene Bank, Ecosystems Resources and Development Bureau, DENR
2. Bambusetum, Ecosystems Resources and Development Bureau, DENR, Laguna
3. Bambusetum, Ecosystems Resources and Development Bureau, DENR, Baguio
4. Palmetum, Ecosystems Resources and Development Bureau, DENR, Laguna
5. Gene Bank of Medicinal Plants, UP Los Baños

*Captive Breeding Facilities*
1. Ecosystems Research and Development Bureau, DENR, Laguna
2. Protected Areas and Wildlife Bureau, Quezon City
3. Silliman University, Negros Oriental
4. Philippine Eagle Conservation Center, Davao
5. Philippine Raptor Research and Conservation Center, UP Los Baños
6. Calauit Wildlife Sanctuary, Palawan
7. Crocodile Farming Institute, Palawan
8. Bird International, Inc., Quezon City
9. Simian Conservation Breeding Research Center
10. Scientific Primates Filipinas, Inc.
11. A.T. Virri Primate Breeding Corporation
12. Del Mundo Trading
13. Ferlite Scientific Research, Inc.
14. Amo Farm
15. Flora Farm

**INFORMATION RESOURCES**

*Data Bases*
1. Philippine Plant Inventory Data Base, Flora of the Philippines Project, National Museum
2. Philippine Fauna Data Base, Zoology Division, National Museum
3. Museum of Natural History Data Base, University of the Philippines Los Baños
4. Critical Plant Sites Data Base, Biodiversity Information Center, National Museum
5. Rare and Endangered Plants Data Base, Philipine Center for Plant Conservation

*Bibliographies*
1. A Bibliography on Biodiversity Research in the Philippines-Plants, 1992, by Domingo A. Madulid and Esperanza Maribel G. Agoo, National Museum, Botany Division
2. Bibliography on Philippine Ethnobotany, Ethnopharmacology and Related Subjects, 1994, by Domingo A. Madulid and Ferdinand J. M. Gaerlan, National Museum, Botany Division
3. The Flora and Fauna of the Philippines (1851-1966): An Annotated Bibliography, 1969, by Catalina A. Nemenzo
4. Diversity and Conservation of Philippine Land Vertebrates: An Annotated Bibliography, 1992, by D.S. Balete, H.C. Miranda, Jr, L.R. Heaney, and J.F. Rieger
5. The Birds of the Philippines-An Annotated Checklist, 1991, by E.C. Dickinson, R.S. Kennedy, and K.C. Parkes.

*Libraries*
1. National Library
2. Philippine National Museum
3. University of the Philippines Diliman
4. University of the Philippines Los Baños
5. Department of Science and Technology
6. National Research Council of the Philippines, Bicutan, Metro Manila
7. Department of Environment and Natural Resources
8. Protected Areas and Wildlife Bureau
9. Environmental Management Bureau
10. Ecosystems Research and Development Bureau
11. Philippine Council for Agriculture and Natural Resources Research and Development

macrophytes, are concentrated in the UP System (UP Los Baños and UP Diliman) and the PNM. Manpower capabilities for biodiversity research are admittedly limited and must be seriously addressed if a National Biodiversity Strategy and Action Plan is to succeed. Training programs and tertiary curricular programs must be instituted to accelerate the build up of manpower. Actual inventories of the flora and fauna of wetlands must be conducted and completed, to serve as the foundation of biodiversity conservation and sustainable use. More scientists from the academe should be tapped and provided adequate logistics to accomplish these. In the process, species found to be of great importance may be considered for biotechnology research.

Data base information on biodiversity of Philippine wetlands are just being established, with this assessment representing possibly the first comprehensive inventory of floral and faunal species ever to be attempted. Being literature based and limited by time, efforts were mostly directed to better understand the levels of endemism, range of distribution, species richness in biogeographic zones, assessment of biological values/services and assessment of institutional and manpower capabilities. These underscore the necessity of actual visits to repositories of biological specimens, such as the PNM, UPLB Museum of Natural History and the Biological Museum of San Carlos University. Assessment of the actual collections representing wetland species would require time and effort. At this seminal phase of generating data base information at PAWB, setting up similar data bases in the UP System where most scientists working on biodiversity are concentrated may prove beneficial to all wetland stakeholders. Linking with the Asian information network by providing appropriate computer systems will also facilitate access to foreign literature needed in comprehensive surveys of biodiversity and their endemicity.

### 3.4.3 Marine Ecosystem

The national institutions directly or indirectly involved in coastal and marine biodiversity conservation in the Philippines are the DENR and the DA. In the DENR, it is the direct mandate of the PAWB and the ERDB. The NAMRIA, another unit of the DENR, is mandated to provide the government with map making services and to act as the central mapping agency, depository, and distribution facility for natural resources data in the form of maps, charts, text, statistics, etc. It is undertaking an AIDAB assisted project called the Philippines-Australia Remote Sensing Project on Coastal Resource Mapping of Critical Bays in the Philippines using remote sensing. At the regional level, the PENRO is the legal arm of the DENR that implements its mandates and enforces its policies and rules.

While at the DA, it is BFAR which is responsible for the development, improvement, management, and conservation of the country's fisheries and aquatic resources. One of the most important projects being administered by BFAR is the Fisheries Sector Program (FSP) which consists of six components: resource and ecological assessment; coastal resources management; research and extension; credit; infrastructure and law enforcement.

The PNM is the Philippine institution devoted to the procurement, care, study, and display of all objects of lasting interest or value in the country. Under limited circumstances, personnel of the PNM have been involved in the assessment of certain coastal areas of environmental importance.

The National Power Corporation is mandated to develop and generate cheap and reliable electricity for national development and the exercise of complete jurisdiction and control over watersheds surrounding the reservoirs of plants or projects constructed or proposed to be constructed by the corporation.

The NEDA, an independent planning unit of the government, evaluates the technical, financial, and economic viability of development assistance funded projects. The Director-General of NEDA heads the Philippine Council for Sustainable Development (PCSD)

The National Irrigation Administration is mandated to study, improve, construct, and administer all national irrigation systems in the country and undertake projects such as flood control, drainage, land reclamation, hydropower development, reforestation, and other related activities.

The PCAMRD is mandated to formulate strategies, policies, plans, programs, and projects, for fisheries and aquatic resources research and development, program and allocate government and external funds for research and development; monitor research and development projects and generate external funds.

The major biodiversity-related programs of the PCAMRD include: monitoring, assessment, management, and conservation of marine fisheries

resources; promotion of environmental protection and rehabilitation of shallow coastal areas; diversification and expansion of viable aquacultural industries; and the assessment of oceanic water including the Exclusive Economic Zone

The Palawan Council for Sustainable Development is mandated: to achieve regional balance in social and economic opportunities including income distribution and access to social services, to develop areas with large under utilized resources for economic growth, and improve agricultural productivity to create employment and raise the income of rural populations in Palawan.

The UP MSI is a unit of the College of Science of the University of the Philippines, Diliman, Quezon City. The UP MSI has just become the National Center of Excellence in Marine Science. It is mandated: to generate basic information necessary for optimal and sustained utilization, management, and conservation of the marine environment and its resources, to provide graduate level training and extension services to develop manpower requirements in marine science, and to develop appropriate and environmentally sound technologies for industrial and economic development in the marine ecosystem.

### Private Institutions

A number of non-government institutions are active in biodiversity conservation and management of marine ecosystems in the Philippines. They include:

The International Center for Living Aquatic Resources Management (ICLARM), an autonomous, non-governmental scientific research center. ICLARM conducts, stimulates, and accelerates research on the development and management of living aquatic resources to assist developing countries meet their nutritive, economic, and social needs. This institution has engaged in a variety of marine studies and has provided analytical methodology and training to boost efforts in the region and in the world. It has three research programs with implications to marine biodiversity conservation. These are the Coastal Resource Systems Program, the Coral Reef Management Program, and the National Research Support Program

Two significant contributions of ICLARM, with support from the UN Food and Agriculture Organization (FAO) and the European Union (EU), to current awareness and understanding of global biodiversity are the FishBase and ReefBase. FishBase is a global database which combines key information on fish with time series data on their occurrence and abundance and with their currently recognized status of threat (with CD-ROM version). On the other hand, ReefBase is a global database of coral reefs, documenting the location, extent and depth zonation of the reefs and their exploitation and conservation status.

The Asian Wetlands Bureau (AWB), an international NGO, aims to promote the sustainable use and protection of wetlands in the Asia-Pacific region. Its mode of operation is: to maintain an overview of the conservation status of wetlands in the region, to assist in the development of regional and national wetland action plans, to disseminate information on the importance of wetlands and promote information exchange, to provide support to local organizations in managing wetlands on a sustainable basis, to provide linkages with international organizations and expertise outside the region and to secure funding for wetland conservation projects within the region.

The World Wildlife Fund for Nature (WWF), effected the first debt-for-nature swap in the Philippines, agreeing to acquire US$ 2 million worth of debt owed by the Philippines to foreign banks. This money helped fund vitally needed park improvements and training programs. Joining forces with USAID and DENR through the Natural Resources Management Program, it erased US$ 10 million worth of Philippine debt. The centerpiece of the program was the establishment of the Foundation for Philippine Environment (FPE) which provides funds for environmental projects of Philippine NGOs.

The Haribon Foundation for the Conservation of Nature and Natural Resources (HARIBON) emphasizes community based resource management projects, including community education in basic concepts in ecology, leadership skills, resource management, para-legal training, biological and socioeconomic surveys of sites, mangrove reforestation, and reintroduction of species.

### International Union for the Conservation of Nature and Resources

The World Conservation Union (IUCN) is a union of sovereign states, government agencies, and NGOs. The IUCN initiates and promotes scientifically based actions that will ensure the perpetuation of the natural environment.

Other academic and non-academic institutions include those departments or divisions of private universities or research laboratories which have made significant contributions to the field of marine science through collections and identification of specimens, research on coastal resources ecology, and management, and non-governmental organizations involved in marine environmental protection. Foremost among them are Silliman University in Dumaguete City and University of San Carlos in Cebu. More recently, a major contribution to the country's knowledge of its biodiversity is being made by private firms involved in energy power plant construction, coastal development such as ecotourism estates along coasts through their environmental impact statements.

A few national institutions in Southeast Asia have achieved international prominence in marine science. Most notable of these is the Marine Science Institute of the University of the Philippines which conducts a variety of projects on coastal and marine sciences and management. Silliman University mentioned above, a private institution in the central Philippines, has a long history of coral reef research including pioneering work in village based coral reef reserves (Jameson et al. 1995). These two institutions combined forces in the mid-1970s to conduct a national survey of coral reefs of a scope unmatched to the present by any nation except Australia.

### 3.4.4 Agricultural Ecosystem

#### Human Resources

The human resources for agricultural ecosystem conservation come from various institutions throughout the country. As the national agency for rice research and development, Philrice is responsible for unifying and coordinating the research and development activities of more than 60 agencies working on rice nationwide and strengthening the manpower capabilities of major agencies involved in Philippine rice programs. In 1992, Philrice had a total manpower complement of 567 of which, 21 were Ph.D. degree holders, 41 with MS degrees and 176 BS degree holders. Of the total work force, 315 were stationed in the central experiment station, the Maligaya Rice Research and Training Center, in Maligaya, Muñoz, Nueva Ecija; 90 in Midsayap Station, North Cotabato; 36 in San Mateo Station, Isabela, Cagayan Valley; 19 in Agusan Station; and 50 in the Los Baños Office. The Plant Breeding Division engaged in varietal improvement has 29 technical manpower at the main office, 7 at Midsayap, 5 at Los Baños and 10 program/project/study leaders.

The Institute of Plant Breeding (IPB) of the University of the Philippines Los Baños, per 1995 records, has a staff of 292 with 73 as Research and Extension Personnel (REPS) and 4 as Faculty. It has 20 Ph.D. holders, 40 MS graduates and 17 BS/AB degree holders.

Part of the institutional development of the National Tobacco Administration is the strengthening of front-line services units through training. This involves upgrading of technical, physical, and manpower capabilities in the various branch offices to increase their service delivery capability.

The agencies tapped to provide the manpower requirement for the Animal Genetic Resources Conservation Program from the Department of Agriculture (DA) are the following: Bureau of Animal Industry (BAI), Philippine Carabao Center (PCC), Philippine Dairy Corporation (PDC), Livestock Development Council (LDC), and the International Training Center on Pig Husbandry (ITCPH).

The cooperating state colleges and universities (SCUs) are the Institute of Animal Science of the University of the Philippines Los Baños, the Visayas State College of Agriculture (VISCA), and the University of Southern Mindanao (USM). These have human resources for agricultural ecosystem conservation efforts. The PCARRD also adds manpower to the project's resource complement. One responsibility of the program is to train the conservation personnel that would be involved.

#### Technological Resources

As cited earlier, Philrice is equipped with a central experiment station and four branch stations in the country. In addition, Philrice has modern laboratory buildings and equipment donated by the Japan International Cooperation Agency (JICA) which supports its hybridization activities (Philrice, 1992).

In the case of Bureau of Plant Industry (BPI), the component facilities are the National Crop Research and Development Centers that deal with germplasm collection and maintenance, seed technology improvement, etc. They are: the Baguio National Crop Research and Development Center (BNCRDC), which include the Baguio and Buguias Experiment Stations and the Philippine-German Fruit Tree Program; the Davao National Crop Research and Development Center; the Los Baños National

Crop Research and Development Center; the La Granja National Crop Research and Development Center; and the National Mango Research and Development Center in Guimaras.

Plant quarantine service is provided in 12 Plant Quarantine Ports of Entry. On the other hand, seed quality control services are provided by the regional seed testing laboratory. The IPB has the National Seed Foundation building with modern seed production and processing facilities. IPB cooperates with selected state universities and colleges and centers of the BPI in variety development, testing, and increase of desired plant varieties.

The DA's National Artificial Breeding Center (NABC) has cryopreservation facilities for the ex-situ preservation of genetic materials. The NABC together with the animal physiology and breeding units of SUCs may provide facilities for the multiplication and reproduction activities and other studies of the conservation program.

For the in-situ conservation of domesticated exotic and indigenous species, the UPLB has identified an area in its Laguna and Quezon Land Grant where a set-up would be built similar to the tamaraw "gene pool" at Kanturoy, Aguas, Rizal, Occidental Mindoro. In addition, the proposed AGR program is committed to establish an animal genetic resources center in the country.

Information Resources

The present information resources for domesticated exotic species diversity are very inadequate. The domesticated exotic species population census does not at all specify even the various breeds and types of each class of animals. Thus, for instance, in cattle the census does not indicate how many are Indian cattle, Holsteins, or native; neither does it quantify the beef or dairy products.

Data Management and Monitoring Capacity

Support programs of the National Tobacco Authority (NTA) have been implemented such as the mobility program for field technicians and the office automation program for branches to improve data processing and storage capability. Additional functions were devolved in line with the decentralization policy of the government.

The information gathered from the above mentioned agencies and their mandate as well as their programs and projects give an overview of the national capability to monitor genetic biodiversity in agriculture. Assessment of the institutional capacity in terms of human resources, technological facilities, information resources and data management and monitoring capacity would require specific sets of information that can be obtained from key informant interviews.

The domesticated exotic species sector has ample capacity for data management and monitoring in terms of training, expertise and resources in its various agencies in the DA, PCARRD, and SUCs.

### 3.4.5 Protected Areas

National Institutional Capacities

The IPAS Project Coordination Unit (PCU) is the national institution tasked to oversee the implementation of the NIPAS law for the first ten priority sites under the Conservation of Priority Protected Areas Project (CPPAP). At this early stage of the project and the infancy of the NIPAS law, a relatively weak national institutional capacity is a given.

Human Resources

Besides the project staff from the NIPA, Inc. and the DENR-PAWB, the CPPAP is assisted by technical consultants as follows: (a) protected area design specialist; (b) resource economist; (c) legal adviser; (d) indigenous cultural community specialist; (e) training and information education and communication specialist; (f) terrestrial flora and fauna specialist; (g) aquatic flora and fauna specialist; (h) agri-business/marketing specialist; (i) infrastructure specialist; and (j) community development specialist. The staff of the PCU coming from the DENR-PAWB are presented in Table 87. The NIPA, Inc. complements the government staff with 14 staff (3 administrative and 11 technical staff).

Technological Facilities

Other than the usual equipment, such as vehicles, computers, and photocopying machines, among other things, the technological facilities of the project are still at a very minimal level. Although a GIS hardware is available, this has yet to be operationalized. The facilities at the PCU are shown in Table 87.

Information Resources

Information about the sites are relatively scarce and minimal from the management planning and

***Table 87*** *Human and technological resources needed for Integrated Protected Areas System (IPAS) Project Coordinating Unit (National Office)*

| HUMAN RESOURCES | NUMBER OF POSITIONS |
|---|---|
| Project Manager 1 | 1 |
| Project Development Officer V | 2 |
| Project Development Officer IV | 1 |
| Supervising Ecosystem Management Specialist | 1 |
| Senior Ecosystem Management Specialist | 2 |
| Computer Programmer III | 1 |
| Project Development Officer II | 1 |
| Project Evaluation Officer II | 1 |
| Forester II | 1 |
| Administrative Officer II | 1 |
| Clerk III | 1 |
| Driver II | 1 |
| **TOTAL** | 14 |

| TECHNOLOGIAL RESOURCES | NUMBER OF UNITS |
|---|---|
| Vehicles (AUV) | 2 |
| Seed storage | 1 |
| Computer with printer | 3 |
| Typewriter | 1 |
| Office tables and chairs | 10 |
| Filing cabinet | 2 |
| Notebook computer | 1 |
| Airconditioning unit | 2 |
| Overhead projector | 1 |
| Photocopying machine | 1 |
| Public address system | 1 |
| Camera | 1 |
| TV with VHS player and recorder | 1 |
| Binoculars | 1 |
| Tape recorder | 2 |
| Laser printer | 1 |
| Office | 1 |

decision making point of view. This in fact is one of the principal areas that CPPAP will try to address during the next two years. Part of this exercise is to identify data gaps and to determine where they are available. The General Management Planning Strategy (GMPS) is the venue for this concern.

Data Management and Monitoring Capacity

The CPPAP will still set-up its own management information system (MIS). As data are still very limited, data management is almost non-existent at this stage. With regard to the monitoring capacity, the nature of the draft project monitoring plan is such that it requires any monitoring person to be very familiar with the project design, goals, and objectives before he can apply the monitoring system. This is a safeguard against the practice of having a project monitored by persons who are not knowledgeable with the project. The CPPAP monitoring system covers three levels of concerns, these are: (1) coordination level; (2) obligation level; (3) work and financial plan level

Coordination level refers to a management arrangement whereby the degree to which the various offices/individuals directly engaged in the implementation of CPPAP exercise the required coordination at all levels of work. From the national offices down to the site offices, there are very clear coordination relationships which if religiously observed can provide an auspicious quality of team work that will significantly contribute to project success.

The obligation level focuses on the responsibilities of the various offices and individuals involved in the implementation of CPPAP. These responsibilities are specified in the policies of DENR and other project documents such as, technical report, grant agreements, etc. If these responsibilities are collectively regarded as part of the scope of work and not fragmentalized, the room for success is great.

The work and financial level aspects provide a straightforward basis in assessing the progress of work. It is mechanical in character.

The three levels of the Monitoring and Evaluation System (MES) use a whole range of monitoring variables covering national, regional, and site operations. They collectively provide the complete M & E cycle for every M & E event.

Local Institutional Capacities

The local capacity for PA management is low. Institutionalizing local governance is a requirement of the NIPAS law, an issue CPPAP intends to address.

### Human Resources

The host NGOs in the ten sites will hire personnel to support the weak government presence in the protected areas. The host NGOs are currently being selected and contacted, thus no exact figures on personnel are available. The deployment of government personnel in each site is shown in Table 88. At each site, the PAMB is expected to provide some support, particularly its local government unit members.

### Technological facilities

The facilities, basically equipment, needed in each site are shown in Table 89. These facilities will be supplemented by the ones host NGOs will purchase. The level of sophistication of the technological capacity in each site is unavailable.

### Information Resources

The information resources in each site are minimal to non-existent.

### Data Management and Monitoring Capacity

Data management and monitoring capacity are non-existent in each site. A management information system (MIS) and monitoring capacity will be developed by the CPPAP for each site.

# 4.0 MONITORING AND EVALUATION

## 4.1 Forest Ecosystems

### 4.1.1 Biological Components/Indicators

A minimum set of indicators for monitoring biodiversity at the genetic, species, and ecosystem levels have been proposed and is presented in Table 88. Monitoring and evaluation studies are best accomplished by establishing permanent ecological plots and applying standardized methodologies. Priority should be accorded to endemic species, endangered or threatened species, wild or non-domesticated species, critical plant sites, and less studied primary forest formations. So far, only few studies have been made using these indicators.

### Genetic diversity

Genetic variation within species can be measured and monitored qualitatively and quantitatively. Its measurement or estimate is critical in the assessment of the range of differences of individuals within the population and among subpopulations and in the assessment of the general fitness of species in adaptive changes or evolution. Three major types of characters can be identified and monitored to estimate levels of variation, namely: morphological, allozyme, and DNA sequences. So far, some studies have been made on morphological variations within species of some Philippine plants, but hardly any on the allozyme or DNA sequences.

### Morphological variation

Morphological or phenotypic variation can be detected by visual observations on shapes or forms, sizes, and colors of the individuals in a population or subpopulation. Either a continuous or discontinuous variation may be recognized. This is useful in identification of ecotypes and determination of genetically isolated subpopulations.

Breeding techniques can also be applied to detect morphological traits which have been transmitted from parents to offsprings of selected crosses. A series of crosses are done to detect morphological variations in progenies grown in new environments.

***Table 88*** *Number of government personnel deployed to Protected Areas Site*

| | BPLS | NSMNP | SBNP | ARMNP | MCNP | TIMNP | MKNP | AWS | SIWS | MANP | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Personnel | | | | | | | | | | | |
| Chief Ecosystem Management Specialist | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| Forester III | 1 | 1 | 1 | - | 1 | - | 1 | 1 | 1 | 1 | 8 |
| Ecosystem Management Specialist I | 3 | 4 | 1 | 1 | 3 | 3 | 3 | 2 | 4 | 1 | 25 |
| Project Development Officer I | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| Clerk II | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| Forester I | - | 1 | 2 | - | 1 | - | 1 | 1 | - | 2 | 8 |
| Senior Ecosystem Management Specialist | - | - | - | 1 | - | 1 | - | - | - | - | 2 |
| | 7 | 9 | 7 | 5 | 8 | 7 | 8 | 7 | 8 | 7 | 73 |

***Table 89*** *Technological resources needed at each Integrated Protected Areas System (IPAS) site*

| | BPLS | NSMNP | SBNP | ARMNP | MCNP | TIMNP | MKNP | AWS | SIWS | MANP | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Boat | 2 | | 1 | 1 | - | 1 | - | 1 | 1 | - | 7 |
| Base radio station | 1 | | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 11 |
| Handheld radio | 3 | | 3 | 3 | 3 | 3 | 5 | 3 | 3 | 3 | 29 |
| Computer with printer | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| Power generator | 1 | | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 | 8 |
| Typewriter | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| Calculator | 3 | | - | - | - | - | - | - | - | - | 3 |
| Office tables and chairs | 4 | | 10 | 6 | 7 | 4 | 12 | 8 | 6 | 6 | 63 |
| Binoculars | 4 | | 10 | - | 2 | 5 | 1 | 3 | 1 | 4 | 30 |
| Public address system/ tape recorder | 1 | | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| Camera | 6 | | - | 1 | - | 1 | 1 | - | 1 | 4 | 14 |
| Conference table | 1 | | - | - | - | - | - | - | - | - | 1 |
| Executive tables and chairs | 4 | | - | - | - | - | 1 | - | - | - | 5 |
| Filing cabinet | 1 | | 1 | 1 | - | 1 | 1 | 1 | 1 | - | 7 |
| Motorcycle | 2 | | 1 | - | 2 | - | 1 | 1 | 2 | 2 | 11 |
| PASu Residence/Office Visitor facilities | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| Vehicles (AUV) | - | | 1 | - | 1 | - | 1 | 1 | - | 1 | 5 |
| Horses | - | | 4 | - | 5 | - | 3 | - | - | 8 | 20 |
| Compass | - | | 3 | - | - | - | - | - | - | - | 3 |
| Scuba diving gear (set) | - | | 1 | 1 | - | - | - | - | - | - | 2 |
| Video camera | - | | 1 | - | - | 1 | 1 | 1 | - | - | 4 |
| Electric fan | - | | 1 | - | - | 2 | 2 | - | 1 | - | 6 |
| GPS | - | | 1 | - | - | - | 1 | 1 | 1 | - | 4 |
| TV with VHS player and recorder | - | | - | 1 | 1 | 1 | - | 1 | - | - | 4 |
| Overhead projector | - | | - | - | 1 | - | 1 | 1 | - | 1 | 4 |
| Photocopying machine | - | | - | - | 1 | - | - | - | - | 1 | 2 |
| Battery charger | - | | - | - | - | 1 | - | - | - | - | 1 |
| Camera (underwater) | - | | - | - | - | 1 | - | - | - | - | 1 |
| Computer table with chair | - | | - | - | - | 1 | - | - | - | - | 1 |
| Gas stove and tank | - | | - | - | - | 1 | - | - | - | - | 1 |
| Seed storage | - | | - | 1 | - | - | - | 1 | - | 1 | 3 |
| Mask and snorkel | - | | - | - | - | 2 | - | - | - | - | 2 |
| Slide projector | - | | - | - | - | 1 | - | - | - | - | 1 |
| Patrolling paraphernalia | - | | - | - | - | - | 8 | - | - | - | 8 |
| Search light | - | | - | - | - | - | 1 | - | - | - | 1 |
| Spotting scope | - | | - | - | - | - | 1 | 1 | - | - | 2 |
| Tents | - | | - | - | - | - | 8 | - | - | - | 8 |
| Airconditioning unit | - | | - | - | - | - | - | 1 | 1 | - | 2 |
| Notebook computer | - | | - | - | - | - | - | - | - | 1 | 1 |
| | 36 | | 44 | 22 | 29 | 32 | 56 | 31 | 24 | 38 | 312 |

This particularly identifies phenotypic traits which are influenced by the environment.

Allozyme variation

Analysis of allozymes using electrophoresis provides an estimate of gene and genotypic frequencies within populations. It is used to measure genetic differentiation, population subdivision, genetic diversity, and gene flow in populations. At present, this is considered the best measure of levels of genetic diversity as may be influenced by life history, habitat, and breeding systems.

DNA sequences

DNA sequencing involves the determination and analysis of the sequence of bases or nucleotides in the genome which is unique for each individual. Since only a portion of the genome is analyzed, the variation in the sequences provides an almost exact measure of variations of the individuals in a population, evolutionary changes in the species, and changes in the genotype as adaptive responses to significant changes in the environment.

Species diversity

Species diversity can be measured quantitatively in various ways and this can provide a good measure of the quality of environment. However, numerical changes in the species population should be carefully assessed and interpreted.

Species richness

Species richness is basically expressed in terms of number of species present in a defined sampling unit. Accuracy of information relies on correct identification of the specimens. Several studies have been made in the Philippines based on this parameter. However, more work should be done to compare values from different forest types.

Abundance/Density

This is an exact measure of the number of individuals per species. In cases wherein individual counts are difficult to make, the number of modular units per species in a plant community is counted instead. The modular units are relatively constant in size within a species like the shoot of a tree, tiller of a grass, and the leaf and bud of an annual. Another measure of abundance is biomass but this involves harvesting, sorting, and weighing the species lots. The figure relative to the total number of individuals is the relative abundance of the species.

A decline in the density or abundance of each species is usually an expression of environmental degradation. But a decline in the abundance of a species towards an evenness of relative abundance of all species suggests stability of ecological processes.

Studies on species abundance have been conducted in a number of habitats and localities in the Philippines, including sub-montane forests (Pipoly & Madulid, 1995), lowland evergreen rain forest (Bañez, 1991; Madulid, 1993c), forest over limestone soils (Madulid and Agoo, 1995), and mangrove forests.

Community Diversity

Species Diversity Index

A community is a biological organization composed of individuals belonging to different species. Species diversity index is a computation which takes into account the number of species (species richness), number of individual per species and total number of individuals of all species (proportional abundance of species). Several diversity indices are available, namely: the log series, log normal, Q statistic, species richness index, Margalef index, Shannon index, Simpson index, and Berger-Parker index. These specifically highlight the species richness element in the community. The choice of index usually lies on ease in calculation and interpretation.

Evenness or dominance

This is a species diversity index which highlights the proportional abundance of species in a community. A shift towards a higher dominance value in a community indicates that the environmental conditions favor the growth of one species. An approach to a higher evenness value indicates an approach towards climax stage in succession.

## 4.2 Wetland Ecosystems

In all bodies of water for which biodiversity data are to be gathered, information about phytoplankton productivity and biomass at the very least should be included in the monitoring/surveillance program. Observations at the physical (transparency, turbidity, temperature) and chemical levels find greater meaning if their significance in the biota is understood. In this case, time and spatial trends

should serve as complementary information requirements. The frequency of measurement should ideally reflect the occurrence of boom and bust of algal populations.

Unlike the phytoplankton, macrophytes are not easily adversely affected by changes in the environment. All species prosper in increased eutrophic levels and not one species can be an indicator of biodiversity. They may indicate, however, the water quality of their ecosystem. Highly eutrophic waters will have large and diverse populations of macrophytes.

Reports of macrophytes are mainly on their general distribution in the country and with only vague comments (e.g., abundant, occasional, etc.) about their populations. Floristic studies on macrophytes should include quantified information on their frequency, population count, etc.

Reports on primary productivity of water bodies are concentrated on microphytes like phytoplanktons. No significant report on macrophyte productivity is encountered and this should be addressed in future researches.

Not much can be said about monitoring and evaluation of insect diversity of Philippine wetlands at present until actual surveys are initiated. These surveys can, in fact, identify potential biological indicators of specific wetland habitats, as well as the quality of the habitat. Some species may be good for indications on pollution, while many will be good indicators for healthy habitats. As surveys zero in on specific important water bodies, diversity indices and productivity measures on selected insect groups can be possible in relation to other biological components of the habitat such as fish and other economically important species.

### 4.2.1 Biological Components/ Indicators

The biological components of a fishery resource system, such as in aquaculture, may be monitored and evaluated through the following indicators:

a. Production Areas
   - Source of the water supply in freshwater fishpond (natural spring or deep well)
   - Fishpens/ fishcage areas (hectares) existing and newly installed by inland bodies of water like lakes, dams/reservoirs, rivers and other water impoundments by year & location
   - Fish hatcheries in operation (new and existing) by locality and by year
   - Identification of fry grounds by locality and quantity of wild fry production also by locality. In mariculture or seafarming, fishpen/fishcage (hectares) existing and newly installed by locality and year
   - Oyster and mussel farms existing and newly established by locality and by year

b. Production Inputs
   - Species cultured and propagated
   - Type of fertilizers applied (organic or inorganic)
   - Type of feeds given (fresh, dried, pellets, mash form)
   - Pesticides, chemicals, antibiotics used
   - Source of fry/ fingerlings

c. Culture Management
   - Type of culture systems practiced (monoculture, polyculture, extensive, semi-intensive, integrated farming); in sea farms (raft, broadcasting, or bamboo stakes method)
   - Stocking densities per unit area
   - Rate of fertilization
   - Quantity of feeds given
   - Quantity of chemicals, pesticides and antibiotics and frequency of application
   - Culture period (number of months/frequency per year)

d. Production Data
   - Volume of production per unit area per culture period or per year (kg/MT)
   - In hatcheries, number of fry/fingerlings produced per year
   - Other species or fishery products produced and quantity of production per year

e. Problems/ Constraints Encountered
   - Types of diseases and frequency of occurrence
   - Other phenomena

f. Island Fisheries
   - Limnological/ecological monitoring by year and by month
   - Stock/resource assessment: catch per unit effort (CPUE) by species, by month, by year and by inland body of water
   - Methods of catching/gears used and number
   - Sedimentation/siltation rate
   - Resource utilization (activities other than fishing and lake farming)
   - Areas of fishpens/cages existing and installed by year
   - Fish kill or disease occurrence and frequency

#### 4.2.2 Socio-Eonomic Components/Indicators

- Number of households/fishermen/fishfarmers involved or benefiting from the resources by year and by locality
- Income derived from fish farming and fishing
- Number of associations organized by year

### 4.3 Monitoring and Evaluation in Marine Ecosystems

Conserving marine biodiversity requires a wide range of scientific activities, from fundamental biological inventories and ecological research to observations to gauge the progress of management plans. Monitoring—the continuing observation of conditions over time—is a crucial tool in this continuum, for it can provide important information that managers need so that they can make timely sound decisions. Monitoring can show whether variations observed in marine ecosystems are natural phenomena or anthropogenic impacts. It can reveal trends that affect the integrity of ecosystems and the prospects for their sustainable use, and can provide early warning of impending problems.

In the Philippines, inasmuch as the monitoring capabilities are extremely limited, it should follow that evaluation of biodiversity is even more so. While there are efforts towards this direction, these are mainly through desktop interpretation and analysis of the meager data available, so that the outcome of the process is more often incomplete and unreliable. It is unfortunate that these data often become the basis of future projects and, worse, major decisions.

#### 4.3.1 Biological Components/Indicators

A biological indicator, or bioindicator, is a species or a response (numerical, physiological, etc.) of a species or a community which characterizes the condition of the local environment. Hence, presence and absence, behavior and physiology could give useful information on the condition of habitats. There are lists of indicators on the states of the environment and among these are biological variables which could be used periodically to assess pressures on the system. While the operation of this environmental indicator system is still in its infancy worldwide, there has been much detailed research on the use of bioindicators for the detection of pollution and specific pollutants. For example, some marine indicators have been reported from popular and scientific literature: coelenterates, fish, snakes, and marine birds.

In the Philippines, some species and population or community response have been considered as 'indicators' primarily via field observations, although sometimes these are supported by literature. Little scientific studies have been conducted to prove that they are truly so. A few examples, like the condition of the environment associated with their "presence," are listed in Table 90.

### 4.4 Agricultural Ecosystems

A technical working group (TWG) of domesticated exotic species conservation experts shall be formed from various government and private sectors. This group shall be tasked, among others, with drawing up a questionnaire on the identification, documentation, monitoring, and evaluation of Philippine domesticated exotic species for the purpose of biodiversity conservation. This questionnaire shall consist of both biological and socio-economic components. The TWG shall formulate a strategy for collecting these data.

#### 4.4.1 Biological Components/Indicators

This will include the domesticated exotic species, population data specifying the breed and number of males and females used for breeding, system of breeding used, number of females being bred pure, i.e., mated to males of their own breed and classification of the animals by age, morphological characteristics of the domesticated exotic species and animal performance data.

#### 4.4.2 Socio-economic Components/Indicators

This covers information on the farmer, his family, his farm and its environs and his general livelihood.

### 4.5 Protected Areas

The DENR had institutionalized a standard Monitoring and Evaluation (M & E) system (DENR Administrative Order No. 33 series of 1992). PAWB, however, does not use this M & E system in the implementation of the NIPAS Law due to budget restrictions. Instead, PAWB uses a loosely designed and non-standardized M & E system that fits the type of the project to be monitored, the requirements of the contract/project document and the capability of the monitoring group/person,

***Table 90*** *Some biological indicators in the marine ecosystem*

| INDICATOR SPECIES | CONDITION(S) INDICATED |
|---|---|
| *Diadema setosum* (black sea urchin) | – disturbed reef condition |
| *Cyanochloronta* (bluegreen algae) | – high in inorganic nutrients |
| Cymodocea, Halodule: *Halodule uninervis; Halophila ovalis* | – branching in these species indicate limiting light condition; overcrowding generally adverse |
| *Enhalusa coroides; Thalassia hemprichii* | – climax reef condition |
| *Padina* (on top of corals) | – dying coral condition |
| Heavy epiphyte load | – eutrophication (nutrient loading) |
| High species diversity/low abundance | – favorable condition (biological control) |
| Low species diversity/high abundance | – unfavorable condition (physical control) |
| *Halimeda; Caulerpa* | – soft sediment conditions |
| Sargassum | – hard bottom conditions |
| *Dugong dugon* | – sizeable seagrass bed |
| *Sagitta setosa* (arrow worm) | – more coastal than oceanic waters |
| Butterfly fish | – good reef condition |

among other things. It uses a simple feedback system, such as the traditional field validation activity by PAWB staff. This is also characterized by the absence of a standard M & E report format thus allowing each project and M & E staff the liberty to design an independent M & E system. Thus there is non-continuity of the M & E flow in terms of timing and report contents, among other things. Furthermore, this M & E system does not consider the biodiversity components of the DENR projects. This results in non-standardized data which are incomparable.

A major attribute of the Conservation of Priority Protected Areas Project (CPPAP) is the development of an M & E system that focuses on the coordination, obligation, work, and financial plan components of the project. This is an iterative system adaptable to the variations in time and other concerns. The system identifies success indicators that consider biodiversity conservation. The initial set of indicators used by CPPAP includes biological and socio-economic components of protected areas management (Table 91).

# 5.0 RECOMMENDED BIODIVERSITY CONSERVATION AND SUSTAINABLE USE STRATEGIES

Based on the assessment of the status of biodiversity in each sector, a set of broad biodiversity conservation and sustainable use strategies were recommended.

## 5.1 Forest Ecosystem

### 5.1.1 Conservation Strategies

#### Inventory of the Flora and Fauna

A comprehensive inventory of the flora and fauna of a given area is usually the first and initial step in any biodiversity management plan. This will provide biodiversity managers, users, and researchers the basic information about the plants and animals found in the area, their scientific names, locality,

***Table 91*** *Biological / socio-economic components of protected areas management of the Conservation of Priority Protected Areas Project (CPPAP)*

| GOALS | MONITORING AND EVALUATION PARAMETERS* | EXPECTED OUTPUT/INDICATORS | ANTICIPATED EFFECT | DESIRED IMPACT |
|---|---|---|---|---|
| 1. Biodiversity conservation | 1. Status of problems as identified | Mitigated problems | Ecological respite/benefits flow | Enhanced diversity and strong conservation partnership between GOP and the people |
| 2. Sustainable management and development of resources | 2. Consistency with goals/targets | 90 - 99% approximation | Satisfaction of NIPAS law | -- do -- |
| 3. Sustainable development of down-stream economic activities (within and immediately outside the PA) | 3. Ecological indicators (effects) | improved diversity levels in study plots | Increased resource - base for the people (trend) | Stable environment with stable supply of renewable resources and by-products (trend) |
| | 4. Cons. programs participated in by stakeholders | Management unity | Stronger and less politicized mgnt. | An efficient and decentralized system of mgnt. |
| | 5. Degree of subsidiarity in management (PAMB authority) | Fully functional PAMB | Efficient PA Mgnt. | Fully decentralized and functioning PA mgnt. |
| | 6. Status of sub-IPAS Fund | Established account | Financial breathing - space | High income generating sub-IPAS Fund |
| | 7. Policy development & effectivity | Precise policies | Systematic policy development and workable policy sets | Strong policy development capability of PAMB |
| | 8. Knowledge level as practiced | Increased technical capability | Technical mgnt. independence | Delivery of accurate mgnt. prescriptions |
| | 9. GMPS approximation/mgnt. plan approval and applicability | Implementable mgnt. plan | Accurate application of prescriptions | Institutionalized practice of GMPS/biodiversity conservation |
| | 10. Sanctity of buffer zone and boundary | Established boundaries of buffer zone and PA | Strong protection program | PA sovereignty |
| | 11. Congressional action | Republic Acts | PA sovereignty and mgnt. sustainability | Financial allocation and sovereignty. |
| | 12. Harmony between GOP staff, PAMB, communities and concerned entrepreneurs | Management efficiency through unity; management sustainability | Mitigation of threats to conservation | PA conservation in perpetuity (trend) |
| | 13. Livelihood fund | Increased absolute and relative values and broader participation by beneficiaries | Increased subsidy to IPAS fund | Increased amount (absolute) in the recycling of fund. |
| | 14. Tenure servicing | Instruments | Harmony with IPs and migrants; productive lands | Wider participation of tenure holders in PA programs |

**In each site, a detailed presentation of this matrix is advisable for accurate M & E results*

distribution, habitat requirement, ecology, biology, etc. The inventory is a long and tedious task that involves field investigation, specimen collection and identification, species description, and information analysis. The information gathered are usually placed in a computerized database for easy storage and retrieval. The plant and animal specimens collected are kept in herbaria and cabinets for reference use. Priority sites must include protected areas and other biodiversity centers currently recommended for inclusion in the NIPAS.

The Flora of the Philippines Project (see Section 3.2) should be given full support by the government as this will provide the needed basic information on plant diversity in the country. Funding should be sought to continue and complete the project, not just relying on the U.S. funds but from other sources as well.

### National List of Endangered Species

The conservation status of the flora and fauna must be assessed and species which need urgent conservation action should be listed. The list must be supplemented with taxonomic and ecogeographic data. The Flora of the Philippines Project, a nationwide inventory of the rare, endemic and endangered plants of the Philippines began in 1990 and is on-going. At present, a computerized database patterned after the U.S. Smithsonian Species Information System can be generated on Philippine plants with information on their conservation status, locality, distribution, habitat, ecological requirements, and other pertinent information.

### Establishment of a National Botanic Garden

Concerted efforts must be exerted to establish a National Botanic Garden which will showcase the indigenous flora of the country and serve as a center for taxonomic and conservation biology research. The Garden shall be an off-site refuge of the country's rare and endangered species. It may serve as a node in the network of botanic gardens in the country. With recreational facilities, it may also serve as a tourism and recreational center for the general public. A group of concerned scientists, NGOs, POs, and government agencies had been meeting for the past three years to pursue the establishment of a national botanic garden. Their efforts should be sustained and given support by all sectors of Philippine society.

### Public Information Campaign on the Importance of Conserving Forest Biodiversity

Although several research institutes, government agencies and NGOs hold data and information on the nature and importance of forest biodiversity, such information is not effectively disseminated to the public. There is, therefore, a need for more vigorous public information campaign on the radio, television, print and other communication media to reach the widest public.

### Establishment of Biodiversity Information Centers

Biodiversity information centers are needed to service those who want information pertaining to biodiversity. The Biodiversity Information Centers for Plants and Animals set up in the National Museum, with initial funding from the MacArthur Foundation, has accumulated a large database on the subject after three years of work by its full time staff. There has also been established a big library on biodiversity and a computerized database on publications pertaining to biodiversity. The Center serves the needs of the National Biodiversity Unit (NBU), PAWB, students, researchers, and other users. However, it needs continuous funding to extend the operation of the Center. Thus, funds should be sought from Philippine and foreign donors.

### Increase Support for Forest Biodiversity Research Institutions

Only a few institutions and research centers in the country hold large systematic collections of plants and animals found in Philippine forests. Important research institutions include the National Museum, particularly the Botany (Philippine National Herbarium) and Zoology Divisions and the University of the Philippines in Diliman and Los Baños. These institutions should be given adequate funds to house and properly store and preserve specimens of flora and fauna found in the forests. They should be given bigger budgets to maintain and expand their libraries on forest biodiversity. Other institutions whose mandate consists of or includes forest biodiversity conservation should also be given sufficient budget for equipment, research, and operating expenses. Among these institutions are the FMB, ERDB, and PAWB.

Some Recommended Research Thrusts

*Population studies.* The biology of endemic and endangered species of plants and animals found in the forest is poorly known and must be studied. Information on their density, distribution, reproductive biology, nutrition, and habitat requirements is needed in the drawing up of conservation measures for the rare and endangered plants and animals in the forests.

*Ecological studies.* Long-term ecological plots must be established in different vegetation types around the country to serve as sites for the study of all forest biodiversity components from microorganisms to higher plants and animals. A standardized methodology which applies to all life forms is being considered by international scientists. This would allow researchers to gather basic information on the biodiversity of the different vegetation types, vegetation and community structures, ecological relationships, environmental factors, and to monitor changes on these parameters through time.

*Re-introduction studies.* For species where *ex-situ* strategies have been successful, experiments on re-introduction must be pursued. This would initially require, aside from the biological aspect, a thorough assessment and rehabilitation of the original habitat of the species. A close monitoring study must be undertaken upon re-introduction of the species.

Mapping of Biodiversity using Geographic Information Systems.

A geographic information system must be used to manage and analyze spatial data on biodiversity. However, this would require detailed and precise data inputs from thorough field surveys.

5.1.2 Sustainable Use Strategies

Forest Management Strategies

*Forest rehabilitation.* The forests in the Philippines are degraded in varying degrees and only 10 percent remain as virgin primary forest. This is due mainly to logging, kaingin, encroachment, natural calamities, soil erosion, run-offs, etc. Some of the strategies to rehabilitate degraded forests are: implementation of integrated social forestry (ISF), selective logging, assisted natural forest regeneration project, and nationwide reforestation. Some of the proposed strategies consist of monitoring and the strict implementation of the forestry master plan and NIPAS. This is a long term plan and will involve the DENR, LGUs, NGOs, AFP, NPC, etc.

*Enforcement of forest protection laws.* There are numerous laws, orders, and decrees in the country promulgated by Congress or signed by the President to protect our forests and wildlife. Among these are P.D. 705 and EO 277. However, past and present experience tells us that despite these laws, our forests are still being denuded at a fast rate. Future strategy should involve strengthening the implementation and simplification of procedures of EO 277, encouraging closer involvement of communities living in or near the forests and clear delineation of forest protection boundaries. This is a long term project and will involve the same government agencies, NGOs, LGUs mentioned earlier.

Development of Opportunities for Forest Biodiversity

*Prospects for economically important products.* Many hitherto unexplored plant and animal species have good potentials as medicine, food, dyes, tanning material, ornamentals, etc. Some bioprospecting efforts are currently being made to tap these potentials so as to contribute to our socio-economic development. However, biosprospecting is now regulated under EO 247. Executive Order 247 was signed by President Ramos on May 18, 1995, which prescribes the guidelines and establishes a regulatory framework for the prospecting of biological and genetic resources, their by-products and derivatives, for scientific and commercial purposes, and for other purposes.

*Species domestication and breeding for productivity.* Many of our commonly raised agricultural crops like sugarcane, banana, corn, coffee, and leguminous vegetables have been domesticated from the wild. Some process of breeding and acclimatization have made them suitable for large scale cultivation in the open. Further explorations could lead to the discovery and domestication of more species, although monoculture of these, in general, is not recommended because of possible massive pest outbreaks.

*Biodiversity conservation and management by local/ indigenous communities.* Local communities, especially the ICCs/IPs have intimate knowledge and

understanding of many local species. Biodiversity conservation and management programs that are tied up to their local setting and indigenous knowledge system and practices have potentials for success.

*Ecotourism.* Ecotourism offers opportunity for people to appreciate and enjoy nature without disturbing its ecological integrity. Nature, like the forest, is best enjoyed in its inherent diverse condition. Coupled with an intensive information, education and communication (IEC) strategy, ecotourism helps promote a people-based environmental action. A nature tourism development strategy must be developed which integrates considerations of the carrying capacity of the area, income generation possibilities, and opportunities for environmental education. A continuous assessment and monitoring of the biodiversity quality and quantity must be done. The allocation of income for the protection and conservation of the site and for the development of self-financing scheme has to be assured. The creation of a tourism board of multi-sectoral composition (local and national government, non-governmental organizations, scientists, tour operators, and local inhabitants) will facilitate the planning and management of the ecotourism industry in the different sites or protected areas.

*Biotechnology.* The benefits of biotechnology in the sustainable use of our biodiversity and in economic development can not be underestimated. However, guidelines are needed to address the potential impacts of development, testing, and use. This should include an assessment of the ecological and socioeconomic impact of the products of biotechnology and regulation in the use of biotechnology to prevent excessive uniformity of plant and animal varieties. A system must also be developed to monitor and control new biotechnologies and to compensate farming communities affected by this. And most especially, there is a need to train people to undertake the challenge of biotechnology. Incentives must be established and offered to all parties involved in the research and development of the products. The patent system in the country must be strengthened to include all parties who contributed to the development of the product and to ensure equitable shares in benefits or returns. The issue on IPR in biotechnology in the Philippines was discussed recently during the 4th ASEAN Science and Technology Week (Martinez, 1995).

## 5.2 Wetland Ecosystem

Since insects represent numerous species, many of which are endemic, to focus on individual species as a conservation strategy would become too unwieldy and impractical. As mentioned previously, the habitat approach would be best for conserving insects. Once the particular habitat is protected, most of the contained insect species would indirectly be protected. The implementation of laws on the protection of watersheds and remaining forests would go a long way in conserving endemic insect species. While these habitats continue to be protected, actual surveys of insects of wetland habitats must be pursued to validate the existing inventory and complete the inventory. In protected areas where human settlements exist, community efforts must be encouraged to rehabilitate deteriorating mountain slopes and watersheds through the many reforestation and aforestation programs which are already being implemented by the forestry people. The replanting of native tree species must be encouraged in favor of introduced species in order to restore the natural habitats of the associated insects and other organisms.

## 5.3 Recommended Marine Biodiversity Conservation and Sustainable Use Strategies

If one considers the fundamental functions of coastal ecosystems and their potential role in coastal environmental and socioeconomic well being of coastal populations, it becomes imperative to use the resources on a sustainable basis. Hence, integrated coastal zone management should be the goal. The strategies to attain this goal include: establishing national plans; fostering cooperation, implementation of policies for sustainable use, expansion of resources, legislation and proper administration, and adherence to appropriate recommendations.

In terms of priorities, the conservation strategy should focus on developing and maintaining ecosystems rather than sites. It should give highest priority to areas in the country with the highest marine biodiversity and with high numbers of endemics or species per unit area. The latter may be obtained from the initial results of fitting the data into the country's biogeographic zones. The second priority should be focused to those areas with moderate biodiversity values but possessed of

substantial natural habitat that is under threat. The specific measures should include supporting policy change, promoting linkages on conservation with the grassroots, mobilizing financial resources, strengthening institutional capacity, and developing model projects.

### 5.3.1 Establishing National Plans

Out of an awareness to protect and preserve biological diversity and to maintain ecological balance, national governments in the region are currently actively implementing means to conserve and integrate management of marine resources. However, the process of committing resources to address coastal zone issues has been slower than desirable due to the higher priority given to terrestrial rather than marine concerns (Gomez, 1988). Consequently, enforcement of environmental policies are rendered ineffective. These facts have led to skepticism of the bureaucracy by the people, with the subsequent erosion of public participation in information exchange among scientists, environmental planners and resource managers (Fortes, 1989).

Among the countries of East Asia, only the Philippines has formulated (but not implemented) a National Seagrass Management Program and proposed the creation of a Philippine National Seagrass Committee. The Program is envisioned to consist of five major components, namely: resource mapping and survey; research and development; information dissemination, education, training, and publication; environmental management; and policy and legislation. More recently, seagrass transplantation and artificial seagrass systems are experimentally being used to rehabilitate some degraded coastal areas in the country. In Calancan Bay, a copper mining company was allowed to continue operations, with the submission of a rehabilitation plan which includes seagrass transplantation and artificial seagrass systems as a precondition. The relative success of the technique in the enhancement of local biodiversity and providing effective plant cover of otherwise biologically desolate shallow zones has been a strong argument for their use in the rehabilitation of similar areas—a major goal of the Philippine Strategy for Sustainable Development. In addition, the techniques have become a part of the mitigation measures for the environmental impacts of major industrial and energy projects near coastal areas. The comprehensive Coastal Environmental Program (CEP) of the DENR has incorporated a training component which focuses on the importance and use of seagrass systems in the sustainable use and protection of coastal areas. Pauly and Chua (1988) proposed, among others, the replanting of seagrasses as a necessary complement to any fishery management or pollution control scheme in Southeast Asia.

### 5.3.2 Fostering Cooperation

A serious limitation of funds is a main problem in the conservation of biodiversity in the Philippines. But for a number of years, this problem has been addressed through cooperative linkages within and between government and private institutions and international and local funding agencies. The major linkages relating to marine biodiversity conservation have been mentioned above.

An interesting component of biodiversity conservation that has evolved recently are the roles to be played by the NGOs, GOs, POs, and how they relate to one another and the academe. Experience has shown that in technical matters, especially in methodologies and approaches to conserve species and habitats, the NGOs, GOs, POs do not have the needed expertise to undertake projects. In most cases, they request help from the academe, private companies, or organizations. If they get help, they implement the projects without much problem, although in many cases, the results are far from being truly adaptive to local conditions. In other cases, these groups do not get the required technical aid, but still they proceed with the projects, the results often catastrophic in a way that money is practically wasted, data not useful, and the environment left in a condition even worse than before. This is where cooperation between and among the groups are needed.

The academe, on the other hand, while having the required expertise to undertake the technical aspects of biodiversity conservation, is not well equipped to effectively translate the knowledge into a form understandable and acceptable by the local end-users. It requires the help of the NGOs in community organizing and socioeconomic activities to facilitate the implementation of the project. There is thus the need for mutual assistance among the groups, NGOs, and POs providing the local regular

leg work and dealing directly with the people concerned, the academe providing the technical support, and the GOs facilitating the governmental institutional support. The NGOs could also facilitate the mobilization of financial resources.

### 5.3.3 Implementation of Policies

An alternative to dealing with problems *ad hoc* is the Integrated Coastal Zone Management (ICZM), which is aimed at the sustainable use of resources. This is through the implementation of a coherent set of management policies that cover most major habitats and the use of various but coordinated approaches. For Southeast Asia, Table 92 shows the varied types of habitats included in marine protected area management, with the specific strategy adopted for each.

### 5.3.4 Expanding the Resource

Unfortunately, most of the efforts towards environmental protection in the Philippines have focused not on ways to improve development actions and ecological resilience but on curative or remedial actions. But considering the enormous constraints in resources and the limitation of time the country faces, even these curative or remedial actions may be justifiably and significantly helpful in environmental protection. There is an urgent need for a concerted effort and pragmatic actions to mitigate the expected impacts from environmentally degrading developmental activities and consequently expand the resource.

The impacts of the long-term recovery on the value that society places on coastal ecosystems, e.g., coastal stabilization, water column filtering, and fishery habitat, are incompletely evaluated. Yet, given the rate of coastal development and loss of habitats, attention must be given to some remedial measures. Hence, these experiences call for habitat rehabilitation and restoration, applying the most benign, environmentally friendly, technically sound, and cost effective means in attaining its goal of replacing systems which had been destroyed or degraded and to provide for limited specific uses such as aesthetic or amenity purposes. When properly designed, restoration can expand the resource and contribute significantly to the replacement of lost or degraded ecosystem functions and can have a high degree of social acceptability.

One of the techniques currently used in mitigating coastal environmental impacts and expanding the areal extent of coral and seagrass resources, at the same time restoring the biodiversity and productivity of degraded coasts, is the use of restoration technology. This makes use of coral and seagrass transplantation and artificial units. Usually a last option, it involves the alteration of the structure of the ecosystem by applying ecological principles to redirect natural self-organizing biological processes.

***Table 92*** *Major habitat types earmarked for protection in Southeast Asia (management strategies are included, after White, 1989)*

| HABITATS PROTECTED | B | I | M | P | S | T |
|---|---|---|---|---|---|---|
| beaches | | | | x | x | x |
| coral reefs | x | | x | x | x | x |
| endangered wildlife | x | | | | | x |
| estuaries | x | x | x | x | | |
| islands | x | | x | x | x | x |
| mangroves | x | x | x | | | x |
| seagrasses | | | x | x | x | |
| **TYPE OF MANAGEMENT** | | | | | | |
| community-based | | | x | x | | x |
| mooring buoys/signs | x | | x | x | x | x |
| municipal park | | | | x | | |
| national park | x | x | x | | x | x |
| zonation schemes | x | x | x | x | | x |

*B. Brunei Darussalam; I. Indonesia; M. Malaysia; P. Philippines; S. Singapore; T. Thailand*

*Seagrass Transplantation and Restoration.* Over the past 11 years methods and techniques for seagrass bed transplantation and restoration have been developed (Fonseca et al. 1982). Interest in restoration and the number of successful restoration projects especially on land and freshwater habitats are growing as more people understand its significance in maintaining the ecological balance and enhancing habitat value. In the case of seagrass beds, however, there have been no complete restoration successes (Kirkman, 1992). But studies have shown that within one year of transplantation, transplanted seagrass can effectively speed up the cleanup process and more quickly return the environment to a healthy productive ecosystem.

An intensive study on the rehabilitation potential of seagrass transplantation in the region was undertaken in the Philippines. In Cape Bolinao, Fortes (1984) demonstrated the ability of seagrasses to colonize a biologically desolate area and improve plant biomass. In Calancan Bay, an area of about 1,000 $m^2$ around the mine tailings causeway has been transplanted with seagrasses.

After five years, the study demonstrated no significant differences in the growth performance of naturally growing and transplanted materials of the same seagrass species. The only observable but statistically insignificant difference was the slightly lower summer growth rates for the transplanted materials. There was an average annual bed expansion of 32 percent for the transplanted areas compared to the naturally growing areas. The results indicate that even on copper mine tailings, the seagrasses can grow fast and probably regain their usual ecological functions like fish recruitment. There was an increase with time in the number of fish associated with the structures, from 2-17 in 1989 to 22-34 in 1990. The number of fish species caught in the transplanted areas represents 33.3 percent of the total number of fish species recorded from the same western portion of the causeway.

*Artificial Seagrasses.* With limited success, attempts have been made to use artificial seagrass units (ASU) to investigate and monitor the recruitment patterns, change in the diversity of fish communities, and study their potential to improve biomass production in degraded coastal areas. In the Philippines, the technique was used to improve the biodiversity and productivity of a biologically desolate area in Cape Bolinao (Fortes, 1984) and mitigate the impacts of mine tailings in Calancan Bay (Fortes 1994). At the cape, the number of fishes so far identified within the ASUs significantly exceeded that found in natural seagrass beds in the area (Salita-Espinosa and Fortes, 1992). Of the species identified, 62 percent were new to the specific study station, with only 15.4 percent similarity or species overlap with the fish fauna of an adjacent seagrass bed. These results suggest active fish recruitment by the units, implicating the potential of ASUs as effective fish recruiting devices useful as a supplement to improve and rehabilitate otherwise desolate areas.

The 1,000 $m^2$ area in Calancan Bay 'planted' with artificial seagrasses has shown that the technique works by at least attracting a significant percentage of the natural fish fauna in the bay. They have demonstrated relative success in resisting decay and fouling despite the massive colonization of the overhanging structures by plant epibionts. The number of fish species found at the areas with the artificial seagrasses comprises 46.2 percent of the fauna recorded at the nearby seagrass bed and 86 percent of that found in the transplanted seagrass areas.

### 5.3.5 Legislation and Administration

One of the serious needs in the Philippines is the review, formulation and reformulation of relevant legislation likely to have impacts on biodiversity conservation and its sustainable use. There is a clear need to review the identification of responsibilities for all aspects of biodiversity conservation so as to prevent overlaps and conflicts and recommend measures to rectify the situation.

### 5.3.6 Some Priority Recommendations

Some recommendations may be made for the conservation and sustained use and development of the coastal habitats and their resources. These include the following: database development; development of national plans; creating awareness and research promotion; sustainable management; conservation of biodiversity; and education and training.

#### Database development

Database development is a well recognized need insofar as coastal zone management in Southeast Asia is concerned. A regional study under the ASEAN-Australia Economic Cooperation Program (Marine Science) Living Coastal Resources Project, Phase 1, was implemented with three objectives. One of these objectives was to provide a database

for coastal and continental shelf ecosystems with emphasis on mangroves, coral reefs, and soft bottom communities including seagrasses. The result of the project is now the largest database of such nature in the world. For it to be useful, however, it has to be translated into a language that is easily understandable by the direct beneficiaries of the resources.

A significant contribution to biodiversity database in the country is the development and operationalization of the FishBase and ReefBase spearheaded by ICLARM. In addition, some other institutions have developed the capability to effect electronic data acquisition and retrieval through centers established for the purpose (e.g., Seaweed and Invertebrates Information Center or SICEN at the UPMSI). A few other academic institutions have improved their library capabilities to partly cater to specific needs in the marine sciences.

### Development of national plans

Development of national plans includes incorporation of a holistic approach in planning for both scientific research and for environmentally related decisions. In a number of local initiatives addressing management of the coastal zone, the contracting parties now agree to take all necessary measures for the protection of the coastal resource with the recognition of seagrass ecosystems as an essential component of the marine environment. However, in most instances, guidelines which are too general to be useful have been the focus of discussion.

The International Coastal Resources Initiative (ICRI) Framework of Action substantially addresses the need to develop national as well as regional and international plans for marine coastal ecosystems management. The concerns toward biodiversity conservation are fairly incorporated in the agreements, so that they will not be reiterated in this section. In the case of seagrass ecosystems, however, certain points need to be stressed to reinforce the recommendations.

Modified from the resolutions agreed upon at the First and Second Southeast Asian Seagrass Resources Research and Management Workshops (SEAGREMS I and II), the action oriented measures listed below to protect seagrass habitats in the Philippines are recommended. Adapted in part from a similar plan in the Mediterranean, these are based on the rationale that a sustainable environment is achievable only through utilizing ecosystem management principles that recognize the interdependency of humans and their environment:

- With effective enforcement measures, ban bottom trawling and other fishing methods with negative effects on seagrass meadows in shallow coastal areas where these meadows abound;
- Prohibit discharges of urban and industrial effluent to the sea and rivers and sea dumping of dredged material and all kinds of industrial wastes;
- Ban coastal construction like marinas, docks, breakwaters on or close to seagrass beds or reconstruction of beaches with the artificial relocation of sand;
- Promote experimental transplants and restoration in coastal areas where water and sediment quality have been improved;
- Develop public education programs on the conservation and management of coastal marine environment and, in particular, of seagrass meadows;
- Identify environmentally high-risk coastal areas and develop adequate intervention plans to preserve seagrass meadows;
- Establish coastal and marine protected areas wherever meadows of particular scientific or natural interest or areas recognized as important to seagrass conservation are found;
- In areas where information are lacking, develop both basic and impact research on seagrass meadows;
- Develop a database on seagrass to collect and make readily available information regarding geographical distribution, bathymetric distribution, meadow structure and morphology, community structure, status, and environmental use; and
- Develop monitoring activities of seagrass meadows through the establishment of permanent transects to follow the development and behavior of seagrass beds.

### Creating awareness and research promotion

In creating awareness and research promotion, an effective public information campaign on the ecology of seagrasses and other coastal resources and encouragement of research focusing on their frailties

and strengths in the face of a rapidly deteriorating marine environment, should be undertaken. To complement the campaign, programs should be developed so that 'awareness' becomes 'understanding'. Thereafter, the qualities and economic value of coastal systems should be institutionalized through the formulation and implementation of national seagrass management programs. The target audience of such campaigns should be government officials, coastal developers (housing and industrial estates), road engineers and transport planners, aquaculture pond developers, agriculture developers, shellfish/fish harvesters, tourism promoters, urban sanitation officials, the mining industry, port and harbor authorities, international development funding or implementing organizations, educators and legislators. The most compelling and challenging objective of any legislative agenda is the institutionalization of ecological knowledge so that this can be useful in addressing environmental concerns. This is possible through its incorporation in management practices, translation into legislative measures, and infusion in sociocultural norms.

### Implemention of Strategies for Conservation of Biodiversity

As a new scientific discipline, conservation biology or the science of conserving biological diversity, started in the 1980s as an offshoot of the environmental upheaval that swept the immediately preceding decade. Since then, it has become a powerful tool in making and influencing decisions in political, socioeconomic, scientific, and technological circles. This is because directly or indirectly, people benefit from marine ecological services and food from the sea. This is one compelling reason why everyone should share responsibility for the conservation of the coastal and marine biodiversity. In countries of Southeast Asia, the unconditional conservation of seagrass systems remains as the best option to ensure their sustained productivity (Fonseca, 1987; Fortes 1989). However, this western inspired scheme could be grossly unsuitable and unacceptable in developing countries at least at the present stage of their development when a greater percentage of their population is largely dependent upon such resources. Nevertheless, seagrass ecosystem conservation should be a goal and must be built into the decision making process if only to sustain coastal self sufficiency. This difficult task is best achieved when the citizens are well informed so that they can participate in the process, can raise questions about possible choices, and legally ensure compliance with laws and regulations (Norse, 1993).

In the Philippines, a priority area for conservation of marine biodiversity is the Tubbataha Reefs National Marine Park. Similarly, the IUCN has listed for protection, under the Man and the Biosphere Programme of UNESCO, Puerto Galera in Oriental Mindoro and Palawan Biosphere Reserve. Among the Marine Protected Areas in the Philippines, the following have been listed: Apo Island Marine Park, Fortune Island Marine Park, Fugo Island Marine Park, Moalboal Conservation Area, Panglao Island-Balicasag Area Marine Reserve, and Sumilon Island Marine Park.

### Education and training

As guiding principles in the formulation of a program of education and training on coastal resources management, the list below may be useful. They form the basis of and unify the classroom and field activities prescribed in regular school curricula. As much as possible, experiential 'do-to-learn' education should replace the 'read-to-learn' approach. (1) Human beings are part of ecosystems and they shape and are shaped by the natural systems; (2) The sustainability of ecological and social systems are mutually dependent so that a shared vision of desired human and environmental conditions should be developed; (3) It is through an ecological approach that the biological diversity, ecological function, and defining characteristics of natural ecosystems are recovered and maintained; (4) It is desirable to integrate the best science available into the decision process, while continuing scientific research to reduce uncertainties; (5) The best approach to coastal zone management is that which acknowledges that ecosystems and institutions are characteristically heterogeneous in time and space and which integrates sustained economic and community activity into the management of ecosystems; and (6) In the implementation of ecosystem management principles, coordination between government and non-government sectors should be encouraged.

## 5.3.7 The Grand Strategy

In view of the above discussions on how to address pressing issues on marine biodiversity conservation in the Philippines and in Southeast Asia, certain integrative statements can be made. Modified from Norse (1993), these comprise the Grand Strategy Towards Marine Biodiversity Conservation. The goals can be achieved through integrated coastal zone management, capacity building, and improved scientific understanding of coastal ecosystems: (a) there must be no more people than the environment

can support without losing our biological goods and services; (b) we must consume no more than the earth can sustainably yield, hence, we must live off the interest and not deplete the capital; (c) our institutions must be reconfigured to sustain, rather than degrade, our planet's living systems; (d) we need to learn more about natural and human systems so that we can harmonize them; and (e) we need to value biodiversity as the source of our wealth and sustenance.

## 5.4. Agricultural Ecosystem

### 5.4.1 Establishment of Living Gene Banks through On-Farm Agrobiodiversity or *In-situ* Conservation under Traditional Farming Systems

Traditional farmers are known to have actively managed and enhanced the germplasm by selecting for a changing spectrum of needs. They have consistently maintained biodiversity, planted mixed crops systematically to achieve natural crosses, practiced selection and set up their gene banks as well as exchange systems for acquiring genetic resources.

### 5.4.2 *In-situ* Conservation of Wild Relatives

This will require the basic understanding of the needed interface between varietal agrobiodiversity and ecosystem agrobiodiversity. The wild germplasm of use in agriculture and forestry should be maintained within its natural ecosystem.

### 5.4.3 Information and Education Campaign

To encourage farmers raising the remaining indigenous domesticated exotic species as to the importance of conserving them.

### 5.4.4 Set up a Buy-Back/Save the Herd Scheme

The government or an appropriate organization will buy the breedable indigenous domesticated exotic species about to be slaughtered by the farmers, or to provide incentives for farmers to keep these animals for biodiversity conservation.

### 5.4.5 Establishment of a Nationwide Dexotic Species Diversity Conservation Network

This will include both government agencies and the private sector. This network should provide the sharing of expertise and technological facilities. Through this network *in-situ* and *ex-situ* conservation activities will be planned, implemented, monitored, evaluated and improved.

### 5.4.6 A Domesticated Exotic Species Diversity Conservation Program

This program should be a component of the government's domesticated exotic species development program. As a source of supply of domesticated exotic species-based food requirements of our growing human population, the indigenous animals are direly insufficient in quality, quantity, and ability to produce. It is imperative to import both processed animal products for direct consumption, and live animals for breeding or upgrading of local stock for higher production performance.

### 5.4.7 Manpower Development for Biodiversity Conservation

A training program on domesticated exotic species diversity conservation should be drawn.

### 5.4.8 Curricular Revisions

On the long term, school curricula should include biodiversity conservation not only of wildlife but also of domestic indigenous animals. Biodiversity conservation of the indigenous genetic materials is new in the domesticated exotic species sector where the idea of progress has been breeding and/or upgrading: select the better offspring, cull the low producer and slower parents. Thus, the ancestors of high-producing European breeds of cattle, the wild *Bos primigenius* and *Bos longifrons* are now long extinct. With the general objective of establishing a cooperative effort for the identification and monitoring of Animal Genetic Resources (AGR) leading to their conservation, management and eventual utilization under local conditions of the Philippines, various units of the DA, the PCARRD and some SCUs recently proposed to organize a project.

The identified specific objectives of the project are:

a. To establish a network of cooperation of AGR conservation experts.

b. To identify, select and monitor AGR in the different regions of the country.

c. To establish a data bank system for Philippine AGR and link up with Asian and global data banks.

d. To train AGR conservation experts on technologies adaptable to local conditions.

e. To preserve and enhance AGRs leading to different breed development suitable for domesticated exotic species raisers.

f. To analyze AGR data and publish AGR publications.

g. To develop project sustainability leading to the second phase of the project.

## 5.5. Protected Areas

The problems described in Section II of this document are the reasons why the collective biodiversity situation of the PAs is in a perilous condition. The infantile stage of the NIPAS program requires the inevitable step of immediately strengthening the institutional requirements to properly confront this depressing reality. This must start with the DENR taking the lead role in frontally handling the herculean challenge and responsibility. Being an agency that possesses the capability to draw the support of both government and non-government organizations, this is where the short term strategies can be fleshed out. The following recommendation/strategies are therefore premised on this consideration:

1. The level of knowledge that will translate into action must be enhanced among the key officials of the DENR regarding the significance of the NIPAS law in conserving biodiversity.

2. The DENR must declare a 5-year NIPAS-focused program for continuous attention and action, including a 2-year capability and knowledge building program for its staff and partners involved in the implementation of the NIPAS law.

3. The DENR must recognize the decentralized system of PA management that will culminate with the PAMB fully operating as "site manager."

4. The DENR Secretary must immediately approve the DENR Administrative Order on the collection of specimens in protected areas in line with the EO 247 on bioprospecting.

5. The DENR must reduce the processes involved in NIPAS policy development to hasten the installation of the basic policy foundation that will aid in catapulting the progress of program implementation.

6. A coordinative framework among the concerned government institutions to assure the application of the required protocols at the site level must be developed.

7. The DENR should expedite the establishment of each PA comprising the system and advocate the allocation of funds for each.

8. The passage by the DILG of clear policy guidelines on the extent of involvement of the LGU in PA management with the assistance of concerned NGOs is urged.

9. The IPAS Fund Governing Board and the NPPSC should work on the strengthening of the IPAS fund, particularly on the flexibility of its management.

10. The DENR should activate the NICO and the PNICO (the NIPAS coordinating units in the DENR regional and provincial offices, respectively) in line with the 5-year NIPAS focused national program.

11. Fund resourcing should be programmed soonest so that financial gaps can be narrowed.

12. A consciousness building promotion at all levels of society should be developed.

13. The implementation and knowledge of the General Management Planning Strategy should be institutionalized.

The CPPAP is one of the macro-strategies developed to meet biodiversity conservation and sustainable use development in the ten sites.

## 5.6 Recommended Strategies Common to All Ecosystems

The following strategies are not ecosystem-specific and are therefore recommended for all sectors:

1. *Social Preparation for People's Participation.* People should not be just informed through public information campaign on radio, television, print, and other communication media. Beyond providing information, strategies should ensure that the people become aware and get involved/ to participate, instead of being passive bystanders,

in the conservation and sustainable efforts of their own environment.

2. *Community Mobilization.* In addition to being prepared and getting involved in environmental problem-solving process, it is suggested that collective community efforts be utilized as strategies in the formulation and implementation of local plans on biodiversity conservation and sustainable use.

3. *Volunteer Resource Development.* An additional strategy is to harness the potential of community residents in acting on their biodiversity concerns. This strategy has been used and tested in various projects. One important thing to consider to make this strategy work is to sustain the interest and capability of volunteers for a long term.

These strategies have been tried and tested in the Comprehensive Integrated Delivery of Social Services (CIDSS), Special Project for Scavengers (SPS), women, youth, services, etc.

# Philippine Biodiversity Assessment:

# STRATEGY AND ACTION PLAN

Based on the comprehensive assessment of the status of Philippine biodiversity, the principal problems, threats, issues, and gaps confronting biodiversity conservation were identified. These in turn became the basis in the formulation of the National Biodiversity Strategy and Action Plan (NBSAP).

# 1.0 PROBLEMS AND THREATS TO BIODIVERSITY AND PROTECTED AREAS

Philippine biodiversity and protected areas currently experience the severe effects of habitat destruction or loss, overexploitation, biological pollution due to introduced alien species, chemical (environmental) pollution, environmental change, and weak institutional capacity and legal mechanisms (see Table 93).

## 1.1. Habitat Destruction or Loss

### 1.1.1 Forest Ecosystem

Habitat destruction or loss of the forest ecosystem has been attributed to (a) man-induced problems or threats which include logging (both legal and illegal), fire, kaingin-making or shifting cultivation, land conversion such as from forestlands to farmlands and for geothermal energy development, and (b) nature-induced problems and threats such as natural calamities (i.e., volcanic eruptions, earthquakes, and typhoons), pests, and diseases.

a) Man-Induced Problems and Threats

Logging, both legal and illegal, though deliberately limited to forest-rich regions, poses the most serious threat to forest biodiversity. As Senator Orlando Mercado noted, commercial logging has caused the reduction in the present forest cover to only 20 percent of the total land area of 30 million hectares (Capco, 1995). This means that Philippine forests now cover only six million hectares, or a little more than a third of the forested area of 17 million hectares in 1934. Of this, only about 600,000 hectares are still considered primary forests. If the current rate of timber extraction continues, all accessible old growth forests of commercial value will be logged out by the end of this decade. As a result of commercial logging and kaingin-making (shifting cultivation), vast areas are affected by severe, sometimes irreversible, erosion and overgrowth of coarse grasses *(Imperata cylindrica, Saccharum spontaneum, Themeda triandra)* and the broad-leafed ruderal weeds. The Forest Management Bureau (1993) estimates that about 100,000 hectares of watersheds need immediate rehabilitation. Watersheds are of critical ecological importance and provide local communities living near the areas with many of their natural resource needs.

Fire has been recognized as a major cause of the destruction of forestlands in the Philippines, dating back in historic times in association with the first agricultural method employed by man in the archipelago (Merrill, 1912). As a man-made factor, the use of fire has resulted in the transformation of forestlands into grasslands that today form a dominant lineament in the landscape. As of December 1993, grasslands already occupy a sizable area of damaged forestlands covering 10.6 million hectares, most of which are in the provinces of Isabela, Nueva Viscaya, Nueva Ecija, and Bukidnon (Forest Management Bureau, 1993). Grasslands are also found in the Cordilleras, Cagayan, Rizal, Palawan, Romblon, Masbate, Cotabato, and Zamboanga. Based on the only record of forest and grass fires within the reforestation areas of the government over a period of 12 years (1961-1972), there were 414 occurrences of fire that burned a total area of 16,183 hectares. These fires killed 30,000,000 seedlings and saplings with an estimated value, in 1972, of 3.7 million Philippine pesos.

Forest and grass fires occur yearly, while kaingin-making continues in nearly every corner of the forestscape of the country, thereby contributing in some measure to habitat destruction and threatening endemic wildlife, both plants and animals, that the forests support (Binua, 1978).

Along with logging, forest fires continue to destroy the remaining forests, and together account for 14 hectares of the 20 hectares of forestlands wiped out per hour in the country.

Even the Banaue Rice Terraces in Northern Luzon, which are included in the UNESCO World Heritage List, are threatened by illegal logging, forest fires, settlement expansion, and other development activities. Said terraces occupy 30,000 hectares and if laid end to end, would measure 48,280 km or half the earth's circumference (Cimatu, 1995).

Soil compaction, surface run-off, leaching, land use practices, and grazing are among the factors that cause habitat destruction or loss in grassland ecosystems.

***Table 93*** *Major concerns in biodiversity conservation and bioresources utilization*

| MAJOR CONCERNS | BIODIVERSITY SECTORS | | | | |
|---|---|---|---|---|---|
| **A. PROBLEMS AND THREATS** | **FOREST ECOSYSTEM** | **WETLAND ECOSYSTEM** | **MARINE ECOSYSTEM** | **AGRICULTURE ECOSYSTEM** | **PROTECTED AREAS** |
| 1. Habitat destruction | Forest fires | | Coral mining | | Encroachment |
| | Logging | | Destructive fishing methods | | |
| | Conversion | Conversion | | Conversion | |
| | Natural calamities | Natural calamities | | Natural calamities | Natural calamities |
| | Pests and diseases | Pests and diseases | Pests and diseases | | Pests and diseases |
| 2. Overexploitation | Commercial timber and non-timber species | Wildlife trade: reptiles, waterfowl, mangrove trees | Commercially Important species: tuna, giant clams | | |
| | Increased demand due to population growth | Increased demand due to population growth | Increased demand due to population growth | Increased demand due to population growth | |
| | Open access | Open access | Open access | Open access | |
| 3. Biological pollution (species level) | Introduction of alien species | Introduction of alien species | Introduction of alien species such as red-tide causing planktons due to reckless de-ballasting of ships | Inappropriate breeding | |
| 4. Chemical pollution | Chemical defoliants | Mine tailings | Mine tailings | Inappropriate farming systems | |
| | | Domestic discharges | Domestic discharges | | |
| | | Hazardous wastes | Hazardous wastes | | |
| | | Agricultural fertilizers pesticides | Agricultural fertilizers pesticides | | |
| | | Oil spills | Oil spills | | |
| | | Siltation due to erosion | Siltation due to erosion | | |
| 5. Weak institutional and legal capacities | Inappropriate policies | Inappropriate policies | Inappropriate policies | Inappropriate policies | Inappropriate policies |
| | Lack of technical expertise | Lack of technical expertise | Lack of technical expertise | | Lack of technical expertise |
| | Shortage of funds | Shortage of funds | Shortage of funds | | Shortage of funds |
| | Weak IEC | Weak IEC | Weak IEC | | Weak IEC |

*Cont'n.* ***Table 93***

| MAJOR CONCERNS | BIODIVERSITY SECTORS | | | | |
|---|---|---|---|---|---|
| **B. ISSUES** | **FOREST ECOSYSTEM** | **WETLAND ECOSYSTEM** | **MARINE ECOSYSTEM** | **AGRICULTURE ECOSYSTEM** | **PROTECTED AREAS** |
| 1. Biotechnology | Development of undesirable mutants<br>Genetic erosion<br>Biological warfare<br>Pest resistance & Introgression | Development of undesirable mutants<br>Genetic erosion<br>Biological warfare | Development of undesirable mutants<br>Genetic erosion<br>Biological warfare<br>Pest resistance & Introgression | Development of undesirable mutants<br>Genetic erosion<br>Biological warfare<br>Pest resistance & Introgression | |
| 2. Ecotourism | Ecological stress<br>Cultural stress<br>Commercialization | Ecological stress<br>Cultural stress<br>Commercialization | Ecological stress<br>Cultural stress<br>Commercialization | | Ecological stress<br>Cultural stress<br>Commercialization |
| 3. Domestication | Genetic erosion | Genetic erosion | Genetic erosion | Genetic erosion | |
| 4. Bioprospecting | Species extinction<br>IPR<br>Genetic Erosion<br>Overexploitation | Species extinction<br>IPR<br>Genetic Erosion | Species extinction<br>IPR<br>Genetic Erosion | Species extinction<br>IPR<br>Genetic Erosion | |
| **C. GAPS** | | | | | |
| 1. Knowledge | Baseline* | Baseline | Baseline | Baseline | Baseline |
| 2. Management** | Various aspects | Management schemes | Various aspects | Various aspects | Operational gaps |
| 3. Policy*** | Various aspects<br>Biosafety | Policy framework<br>Biosafety | Various aspects<br>Biosafety | Biotechnology<br>Biosafety | |

*Baseline: reference point in the assessment of status of biodiversity or bioresources*
**Management: means of intervention vis-à-vis the conservation of biodiversity or bioresources*
***Policy: definite course of action adopted and pursued by government vis-à-vis biodiversity conservation and bioresources utilization.*

Lory Tan

Due to socio-economic development requirements of an expanding population, an undetermined area of forestlands is subjected to continued conversion into farmlands around the country. One very prominent development is the current effort to explore alternative sources of energy, wherein forestlands have been targeted as geothermal energy sites. Among the many sites, Mount Apo Natural Park has not been spared for energy development although it is one of the first ten priority protected areas under the National Integrated Protected Areas System (NIPAS).

b) Nature-Induced Problems and Threats

Nature-induced destruction of forest biodiversity and resources has been recorded in the early 1900s by Merrill (1912). Of the 21 active volcanoes in the county, two recently erupted, viz., Mount Pinatubo in Zambales in 1991 and again in 1992, and Mayon Volcano in Bicol in 1984 and ten years later in 1993, during which diversity-rich tropical rainforests and other vegetation types around their immediate vicinities were destroyed and/or lost along with an undetermined number of endemic and rare species.

Typhoons, which hit the country at an average of 20 per year (range: 15 to 30), also contribute to habitat destruction or loss along their paths. The nature and extent of their effects on forest biodiversity, however, remain unknown. Recently, a series of strong typhoons have visited the country and wrought havoc to certain regions, the most destructive of which was Typhoon Rosing, with international codename Angela, which occurred in November 1995.

Pests and diseases are also considered major problems of forest biodiversity. A good example is the pine bark beetle, viz., *Ips calligraphus (interstialis),* which attacks the pine forest *(Pinus insularis)* of the Philippines. This borer has attacked natural stands of pine trees in Baguio City and neighboring areas since 1959. The borer infestation reached an epidemic scale during the period 1959-1979 resulting in the death of affected trees in about 81,200 hectares of pine forest, leaving behind large denuded patches in Northern Luzon (Veracion, 1978).

### 1.1.2 Wetland Ecosystem

a) Man-Induced Problems and Threats

In most major freshwater marshes and swamps, the main threats are drainage and reclamation. These are clearly evident in Candaba Swamp, Agusan Marsh, Liguasan Marsh, Manlubas Swamp, and Leyte Sab-a Basin, in which poorly constructed drainage for agriculture, mainly rice culture, is observed as a serious threat. Furthermore, the conversion of parts of Candaba Swamp, Agusan Marsh, and Liguasan Marsh into aquaculture ponds will endanger the flora and faunal species in these areas. The continued forest destruction in their watersheds also brings about siltation that greatly exacerbates habitat destruction or loss in wetland ecosystems, as manifested in current conditions of Candaba Swamp, Agusan Marsh, and Laguna Marsh.

Siltation also threatens the major lakes in the country, especially Laguna Lake, Lake Danao (Imelda), Lake Lanao, and Lake Leonard. For the mangal in protected embayments and estuaries, the major threat is "fishpondification" or the massive conversion of mangroves into brackishwater fishponds for the cultivation of economically important aquatic organisms (Zamora, 1995), such as milkfish *(Chanos chanos)* and prawn *(Penaeus monodon)* (Davies et al., 1990). In fishpondification, the disturbance of the mangal is maximal because (i) all standing biomass is completely removed, (ii) soil profile is totally disrupted, and (iii) subsequent regeneration cannot take place (Zamora, 1995). This conversion process has involved 64 percent or 205,500 hectares of 326, 830 hectares of denuded mangal which now constitute brackishwater fishponds.

b) Nature-Induced Problems and Threats

The three major threats to mangrove diversity are infestation of mangrove plants by barnacles *(Pollicipes mitella, Octolasmis cor, Chtamalus caudatus, etc.)* (Rosell, 1986), borer *(Poecilyps falax)* and tussock moth *(Euproctis sp.)* (Sinohin and Flores, 1993; see also Melana and Mapalo, 1995).

### 1.1.3 Marine Ecosystem

a) Man-Induced Problems and Threats

De la Paz and Gomez (1995) summarized the human activities prejudicial to marine coastal ecosystems in Table 94.

b) Nature-Induced Problems and Threats

De la Paz and Gomez (1995) added that "The most serious natural threat to coral reefs can be attributed to the predaceous activities of the Crown-of-Thorns Starfish *(Acanthaster planci),* an echinoderm given to eating corals and capable of devastating 'large areas of reef during a population outbreak, as had happened in reefs off the east coast of Peninsular Malaysia, where the coral was reduced by 70 to 90 percent by an infestation of Crown-of-Thorns' (de Silva in White, 1987). Recovery from the plagued reefs is estimated at 10 to 40 years, unless further infestations occur" (White, 1987). These recovery rates may also apply to damaged seagrass beds and soft-bottom communities.

***Table 94*** *Human activities prejudicial to marine coastal ecosystems*

| ACTIVITIES | END RESULT |
|---|---|
| I. Destructive Fishing Methods<br>1. Dynamite blasting<br>2. Reef-front-bottom trawling<br>3. Muro-ami, kayakas fishing techniques<br>4. Fish poisoning (cyanide)<br>5. Spearfishing<br>6. Collection of rare marine organisms | Habitat degradation, disturbance of ecological balance, depletion of fish stocks, local extinction of populations, biodiversity loss |
| II. Industrial and Related Activities<br>1. Urban industrial pollution<br>2. Oil spill pollution<br>3. Oil drilling<br>4. Mining (mine tailings)<br>5. Upland deforestation<br>6. Wetland conversion to fishponds<br>7. Unsound agricultural practices | Habitat degradation (turbidity, sedimentation), biological degradation |
| III. Tourism and Related Activities<br>1. Coral Trade<br>2. Amateur collecting<br>3. Nearshore construction<br>4. Coral Mining | Local depletion of stocks, minor habitat destruction |

### 1.1.4 Agricultural Ecosystem

a) Man-Induced Problems and Threats

The rapid conversion of agricultural lands into other uses is the most serious problem and threat to agroecosystems in the country. A total of 109,000 hectares of irrigated lands has, over time, been converted into industrial, commercial, and residential uses. If the trend continues, large agrobiodiversity areas face the prospect of irretrievably losing their productive components which are essentially "primary non-renewable and non-replenishable resources unlike forests" (Danguilan, 1995). In an estimate made by Danguilan (1995), the country will need 67,000 hectares of productive lands by 1997 to meet the growing food requirement of the Filipino people. House Bill 1685, in response, has been filed in Congress that seeks to set aside irrigated and irrigable lands as protected areas for agriculture.

b) Nature-Induced Problems and Threats

Natural calamities (i.e., volcanic eruptions, earthquakes, typhoons, tsunamis) have, over the years, caused significant damage or loss of productive agrobiodiversity areas particularly in those parts of the country that lie along their normal paths, such as the agrobiodiversity areas around or near Mount Pinatubo and Mayon Volcano, earthquake sites, and along typhoon paths.

### 1.1.5 Protected Areas

a) Man-Induced Problems and Threats

When adequately conserved, protected areas are free from any actions that could destroy or completely eliminate the spectrum of habitat types that may be present within their respective boundaries. In reality, however, these protected areas receive inadequate protection partly due to lack of institutional support and resources, thus making them vulnerable or subject to all sorts of man-made problems or threats. These also result in periodic changes of their categories from one type of protected area to another. In the ten priority protected areas, many illegal activities contrary to sustainable use are reportedly taking place notably in the Batanes Protected Landscape and Seascape, Northern Sierra Madre Natural Park, Subic-Bataan Natural Park, Mount Kitanglad Natural Park, and Mount Canlaon Natural Park such as:

- Encroachment
- Occupancy
- Gathering of non-timber products

- Trading of rare and endangered marine species (e.g., pink corals in Batanes)
- Coral Mining
- Logging
- Kaingin-making
- Hunting of faunal wildlife (birds, reptiles, mammals)
- Trampling of nesting grounds (marine turtles in the Turtle Islands)
- Fishing by destructive methods (dynamite blasting, reef-front or reef-bottom trawling, cyanide fishing, muro-ami, kayakas fishing)
- Conversion of natural systems into artificial systems (fishponds, farmlands, vegetable gardens)
- Political intervention, bureaucracy and red tape
- Lack of management capacity of local NGOs to manage projects
- Absence of management plans

b) Nature-Induced Problems and Threats

Like the other "biodiversity sectors" in this book, the protected areas are not exempt from threats due to natural calamities, such as volcanic eruptions, earthquakes, and typhoons, and to pests and diseases. A recent example is the eruption of Mount Pinatubo, which resulted in the loss of undetermined vital biotic components of the tropical rainforest and the marine waters in the Subic-Bataan Natural Park.

### 1.2 Overexploitation

Overexploitation has been one of the major threats to many species in our forest, wetland, and marine ecosystems.

In the forest ecosystem, major threats are in the form of overexploitation of commercial timber species (e.g., dipterocarps, kamagong, mabolo, or narra); overexploitation of non-timber species such as orchids, ferns, vines, and rattans; overcollection of faunal species for food, pet trade, ornament, and sports (e.g., birds, mammals, butterflies); and overcollection of animal products (e.g. birds' nest, guano).

In wetland ecosystems, there is overharvesting of plant and animal resources, which are exemplified by mangrove timber for fuelwood, animals for trade (waterfowls, reptiles), and fish and shellfish for food.

In the marine ecosystem, there is also overharvesting of the commercially important marine species, notably tuna and giant clam, and macrobenthic algae such as *Porphyra* and other seaweeds. Marine organisms are overharvested not only due to their edibility, but to their commercial, medicinal and ornamental/decorative demand. Rare gastropods (e.g., species of Coniidae), kapiz shells, and even starfishes are being harvested in all life stages.

All these are traceable to two significant causes: (a) the increasing demand for commercially important bioresources (forest, wetland, marine) and (b) the "open access" nature of these important bioresources.

### 1.3 Biological Pollution (Species Level)

Very little information about the nature and extent of alien species introduction on endemic species is available to date. However, local scientists and researches present some specific cases to this effect. Table 95 shows some introduced species and the method of introduction in the country that have negatively affected the local endemic and indigenous species. Such species include the giant catfish, black bass, white goby, marine toad, golden apple snail, water hyacinth, and water fern.

By and large, the exotic species have been successfully introduced at the expense of the native wildlife (flora and fauna) either directly through (a) predation, (b) competition, and (c) hybridization; and indirectly through (a) parasites and (b) habitat alteration. Thus, many of the indigenous species have disappeared, while others are being threatened by the uncontrolled existence of the introduced alien species.

### 1.4 Chemical (Environmental) Pollution

A pollutant is "any agent which when added to the environment by man creates stress beyond that which would have been occasioned by natural forces alone" (Darnell, 1973). Chemical pollution is now recognized around the world as one of the major reasons for the escalating loss of biodiversity. Indeed, it is perhaps now impossible to find a body of water (lake, river, estuary, sea) or a land area that is free of some form of pollution brought about by human activity. Philippine wetlands and marine waters suffer from pollution due to the following:

(i) sewage and industrial effluents from urban areas (bays and rivers near big cities, e.g., Manila Bay and Pasig River);

(ii) tailings from mining activities (e.g., Calancan Bay in Marinduque, between Negros and Cebu)

***Table 95*** *Exotic species introduced at various times in the Philippines**

| COMMON NAME | SCIENTIFIC NAME | METHOD OF INTRODUCTION | END RESULT |
|---|---|---|---|
| Giant catfish | *Clarias clarias* | Intentional | Probable displacement of the native hito *(Clarias macrocephalus)* |
| Black bass | *Micropterus salmoides* | Intentional | Disappearance of original fish population of Caliraya Lake, Laguna |
| White goby | *Glossogobius giurus* | Accidental ** | Extinction of majority of 15 species of cyprinids from Lanao Lake, Mindanao |
| Marine toad | *Bufo marinus* | Intentional | Depletion of population of several species of native frogs from Dumaguete City, Negros |
| American bullfrog | *Rana catesbeiana* | Intentional | Potential displacement of native frogs |
| Leopard frog | *Rana tigrina* | Intentional | Potential displacement of native frogs |
| Golden apple snail | *Pomacea spp.* | Intentional | Potential displacement of the native kuhol *(Pila luzonica)* |
| Water hyacinth | *Eichhornia crassipes* | Intentional | Modification of native ecosystem |
| Water fern | *Salvinia molesta* | Intentional | Modification of native ecosystem |

* *Many plants have been introduced (intentionally and accidentally) in the Philippines, more than 475 species of which are found in Metro Manila alone. About 225 are found only in cultivation. These introduced economic plants include important species yielding food, cereals, nearly all fruit trees, condiments, many medicinal plants and most of the commonly cultivated ornamentals. Many were introduced in pre-historic times chiefly from the Malayan region but a high percentage have been introduced within the past 400 years, including a great number of American origin (Merrill, 1912).*

** *Inadvertently included with the milkfish, Chanos chanos, in the seeding of Lanao Lake. The white goby is now the dominant fish species in the lake.*

(iii) oil spills from shipping operations (e.g., major ports and harbors around the country);

(iv) agricultural run-off carrying fertilizers, pesticide residues (e.g. lakes, estuaries, etc.);

(v) hazardous wastes (e.g., industrial effluents along major rivers and on estuaries); and

(vi) siltation as a result of erosion from watersheds (e.g., all denuded watershed areas).

Several wetlands are now considered highly polluted: Laguna Lake, Lake Lanao, Lake Mainit, Lake Leonard, Lake Wood, and Lake Pinamlog; Pasig River, Agno River, Pampanga River, Agusan River, Agus River; Manila Bay, Balayan Bay, Tayabas Bay, Maribojoc Bay, Bislig Bay, Panguil Bay, Puerto Princesa Bay, Honda Bay, and Ulugan Bay (Zafaralla et al., 1995).

Other countries have produced evidence that (a) species of birds and other organisms are affected by pesticides, (b) ecosystems are stressed, and (c) population sensitive species are reduced by air and water pollution. Presumably, many valuable endemic species are affected by the stressed condition of ecosystems arising from chemical pollution. However, there is little published scientific analytical studies to show that this is occurring in the Philippines.

### 1.5 Weak Institutional Capacities and Legal Mechanisms

Identified as the major drawbacks in the conservation of biodiversity and sustainable utilization of bioresources in general are: (i) the inappropriate, overlapping, conflicting and obsolete policies and institutions, (ii) the shortage of technical expertise, (iii) the shortage of funds and (iv) the weak information, educational and communication capacities, (iv) inadequate policing mechanisms.

Furthermore, in marine biodiversity conservation,

the poor integration of research and development activities among concerned parties is regarded as a big problem.

# 2.0 BASIC CONSERVATION ISSUES

In all "biodiversity sectors" studied, four basic issues have been raised that relate to biodiversity conservation. These are: biotechnology, bioprospecting, domestication and ecotourism.

*Biotechnology* includes any technique that uses living organisms, or substances from organisms (i) to make or modify a product, (ii) to improve plants and animals, or (ii) to develop microorganisms for specific purposes and uses (Cohen, 1994). *Bioprospecting* (biodiversity prospecting) is the systematic search for and development of new resources of chemical compounds, genes, microorganisms and macroorganisms, and other valuable natural products for their potential use in agricultural and pharmaceutical industries (Sittenfield and Lovejoy, 1994). *Domestication* refers to the taming of wildlife (wild plants and wild animals) for various uses. *Ecotourism* is defined as "tourism that involves traveling to relatively undisturbed natural areas to study, admire, and enjoy the scenery, and its wild plants and animals, as well as the human culture in the area" (United Nations Environment Programme and World Tourism Organization, 1992).

Without doubt, any activities related to or associated with the above factors will bring about innumerable significant ecological and economic benefits to the country. However, the same activities also can potentially bring about significant disbenefits, i.e., risks and dangers, which may include the following: (i) development of undesirable mutants, genetic erosion through monoculture, and biological warfare due to biotechnology, (ii) ecological stress, cultural stress, and undesirable commercialization due to ecotourism, (iii) species extinction and overharvesting due to bioprospecting, and (iv) genetic erosion and biological pollution due to domestication, as may be gleaned from Table 1, all these may endanger the existence of biodiversity if not properly addressed.

# 3.0 GAPS

Three types of gaps are recognized in the comprehensive assessment of Philippine biodiversity in relation to its conservation and utilization, namely: (i) gaps in knowledge, (ii) gaps in management, and (iii) gaps in policies.

## 3.1 Knowledge

Lack of baseline information on the country's biodiversity is recognized by all sectors as a primary constraint to better understanding and effective action for its conservation. In each of the biodiversity sectors, the concrete nature of this gap is as follows:

*Forest Ecosystem* – incomplete knowledge of floral and faunal diversity of Philippine forests, including the biology, ecology, conservation status, geographic, and altitudinal distribution of rare and endangered species; insufficient data to enable accurate delimitation of the biogeographic zones; and unavailability of standard criteria for classifying forest types based on species distribution, ecology, physiognomy, and vegetation structure.

*Wetland Ecosystem* – incomplete knowledge on the different aspects of biodiversity in various categories of Philippine wetlands which include 78 lakes, 421 major rivers, 4 major swamps or marshes, and numerous bays, estuaries, and mudflats.

*Marine Ecosystem*– absence of foundation geographic information system (GIS) on the habitats from which baseline monitoring could be designed to detect impacts and changes on the ecosystems that are ecologically and economically significant; inadequate quantitative baseline measures of temporal and spatial abundance, recruitment and mortality rates of seagrass beds and coral reefs, and data on their associated flora and fauna especially those with critical conservation status; lack of quantitative measurements of physico-chemical correlates with detailed baseline which are useful in delineating biogeographic zones; insufficient studies on indicator species and responses; and inadequate quantification of the values of marine ecosystems and their components.

*Agroecosystem* – inadequate records of land races and wild species of agriculture and their spatial distribution; incomplete data on endemism in agriculture; unsystematic statistics on agricultural plants and animals, especially the descriptors and reporting formats; insufficient records of natural habitats and their biological components; and inadequate record on genetic erosion of important agricultural crops.

## 3.2 Management

Specific management gaps in each 'biodiversity sector' are briefly enumerated below.

*Forest Ecosystem* – lack of management plans/ schemes for non-timber species and weak implementation of management policies.

*Wetland Ecosystem* – absence of a viable management scheme that ensures the application of integrated and comprehensive approach to the country's wetlands conservation and management.

*Marine Ecosystem* – lack of management mechanisms that are proactive, predictive, and participatory, including the inadequacy of rehabilitation and restoration technology to conserve the seagrasses, coral reefs, and bottom resources, and their biodiversity effectively.

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*Agroecosystem* – weak institutional capacity for monitoring and evaluation of agrobiodiversity; and outdated policies, rules and regulations in the light of national requirements for biodiversity conservation, enrichment, and sustainability in agriculture.

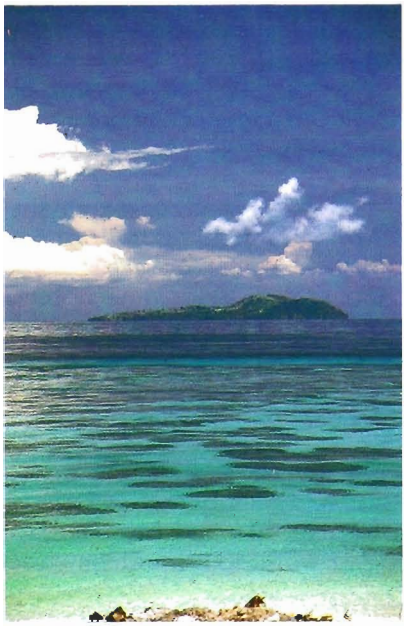
*Protected Areas* – many "operational gaps" related to the implementation of the management plans for protected areas in accordance with the NIPAS Law.

## 3.3 Policies

The specific policy gaps identified are as follows:

*Wetland Ecosystem* – absence of an overriding policy framework for Philippine wetlands.

*Marine Ecosystem* – absence of regulatory and management policies which protect the seagrass meadows and coral reefs; unclear delineation of institutional responsibilities in policy, rules and regulations enforcement; unclear guidelines and policies governing the conservation of biodiversity in seagrass beds, coral reefs, and soft bottom communities; lack of policies for coordinated and integrated marine biodiversity conservation and sustainable use; and inadequate financial mechanisms for sustained conservation and research efforts.



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*Agroecosytem* – inadequate policies concerning biotechnology in the agriculture sector.

# 4.0 GOALS AND OBJECTIVES

Consistent with the three main objectives of the Convention on Biological Diversity, the Philippine National Biodiversity Strategy and Action Plan (NBSAP) envisions a society of empowered, self-reliant Filipinos, well-informed of environment-development relationships, with state-recognized individual and collective rights especially of indigenous peoples, and nurtured by their sustainable use of the country's biological resources. The achievement of this vision will be vigorously pursued by means of the following goals:

1. effective conservation of biological diversity at the genetic, species, and ecosystem levels through improved knowledge and management systems,