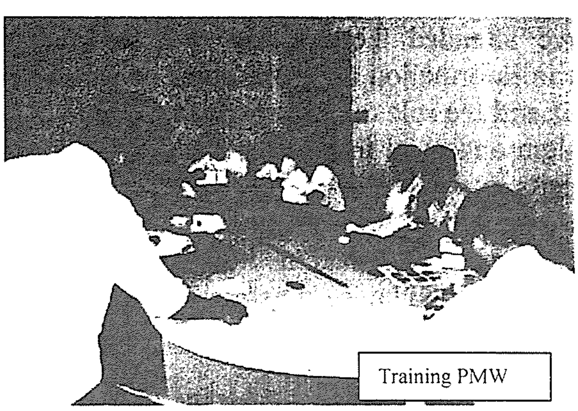
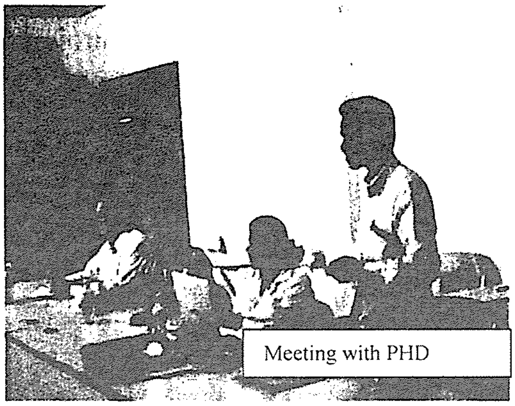
opportunity to the project malaria workers to share their experiences and good practices and also to learn from these and each other. We have offered guidance for implementing activities in their further work in their villages.

Refreshing training showed the result as follow:

No	Name of Village	Number of Trainee	Pre-test	Post-test	Percentage of improvement
1	Dong	2	76%	91%	15%
2	Mlech Koul	2	69%	94%	25%
3	Anlong Mac Prang	2	65%	97%	32%
4	Trapang Kok	2	57%	70%	13%
5	Dom Rei Phong	2	53%	73%	20%





2. *Monitoring and supervision of Project Malaria Worker activities*

Every week the supervision team went to the project villages to observe the activity being done by the project malaria worker, especially the schedule time for disseminating malaria health education to target population and also the project malaria worker has attended the monthly meeting with the project team from National and provincial level at the Pagoda. The commune data record sheets are checked routinely as the results showed the information as below:

Data collected on routine work of PMW every month from June 2006 to February 2007 in 5 project villages

Month	*Total house hold*	*Total pop.*	*House hold increase*	*Pop increase*	*Land transfor m ation*	*The patients with fever*	*RDT(+)/ RDT tested*	*Patient treated with A+M*	*Refer to HCs*	*Case dead*
June	**899**	**4657**	**4**	**17**	**85 hectare**	**28**	**19/27**	**19**	**1**	**0**
July	**912**	**4739**	**13**	**82**	**75 hectare**	**26**	**14/23**	**14**	**3**	**0**
August	**912**	**4739**	**0**	**0**	**36 hectare**	**29**	**20/29**	**20**	**0**	**0**
Sept.	**912**	**4739**	**0**	**0**	**102 hectare**	**29**	**21/28**	**21**	**1**	**0**
Oct.	**912**	**4739**	**0**	**0**	**16 hectare**	**33**	**28/33**	**28**	**0**	**0**
Nov.	**912**	**4739**	**00**	**00**	**23 hectare**	**19**	**16/19**	**16**	**0**	**0**

Dec.	**912**	**4739**	**00**	**00**	**00**	**24**	**18/22**	**18**	**2**	**0**
Jan.	**912**	**4739**	**00**	**00**	**00**	**16**	**12/16**	**12**	**0**	**0**
Feb.	**912**	**4739**	**00**	**00**	**00**	**08**	**06/08**	**06**	**0**	**0**

3. *Provide accurate diagnosis and treatment.*

Project Malaria worker who are working in the project areas were trained to recognize the signs and symptoms of malaria, especially who has the fever and most suspect to malaria patients must make the diagnosis by using rapid diagnosis test (RDT) and treated with anti malaria drug according to their age group and following the CNM treatment guidelines.

Result of patients with RDT positive by age group and treated every month from July 2006 to February 2007 in 5 project villages.

Monthly	*0-4 year*	*5-14 year*	*15-49 Y (Male)*	*15-49 Y (Female)*	*>49 Y (Male)*	*>49 Y (Female)*	*A+M2 blister*	*A+M3 blister*	*A+M4 blister*
June	00	01	16	02	00	00	00	01	18
July	00	02	08	03	01	00	00	04	10
August	00	06	10	04	00	00	02	05	13
Sept.	00	05	13	01	02	00	02	05	14
Oct.	00	02	26	00	00	00	01	05	22
Nov.	00	01	14	01	00	00	00	01	15
Dec.	00	05	11	01	01	00	00	06	12
Jan.	00	02	07	02	01	00	00	02	10
Feb.	00	00	00	03	03	00	00	00	06
Total	00	24	105	17	8	0	5	29	120

Summary data collected during 9 months from June 2006 to February 2006 in 5 project villages.

Total house hold	Total pop.	House hold increase	Pop increase	Land transform ation	The patients with fever	RDT tested	RDT Positive	Patient treated with A+M	Refer to HCs	Dead case
912	**4739**	**17**	**99**	**337**	**204**	**205**	**154**	**154**	7	**00**

From June 2006 to February 2007, 154 positive cases were reported in the 5 villages, which give the malaria prevalence of 75.1% among patient with fever and suspect malaria cases and all of them treated with anti-malaria drug on time and no severe case and also dead case reported.

4. *Improve knowledge and skills of residents to prevent from malaria*

New 1500 impregnated mosquito nets were provided for all the families in the 5 project villages and 180 nets were re-impregnated by the project malaria worker.
On the regular schedule for malaria health education, as the stakeholders they understood how to prevent themselves avoid from malaria, where they could go for treatment when they get sick and the importance of the impregnated bet net use and also most of them knew that malaria can be prevented by sleeping under treated net every night.

IEC materials related to Early Diagnosis and Treatment and sleeping properly under mosquito nets and also using the process to do impregnation of bed nets distributed in the 10 project malaria workers in 5 project villages.

Treated net distributed to the community in project villages (Stung Keo commune)

Conclusions

The results of the second phase project showed that under responsibility of the local villager on providing early diagnosis and treatment on malaria patients where located nearest their houses, no severe cases were recorded in the newly endemic malaria region and also no death case reported.

The regular provision of health education on malaria prevention and treatment has also played a role for the success of the project based on using impregnated bed nets and contributing for early diagnosis and treatment.

Malaria morbidity data collected from project malaria worker in the Stung Keo commune in second phase of the project increased in its rate when compared with the data collected during three months of first phase project. This difference is due to the full implementation by the project malaria worker from June 2006 to February 2007 with the better supply of the malaria drugs and RDTs. Especially, the majority of villagers believe that their project malaria worker was so accessible for their treatment with no amount spent by them.

This project has strong impact and a significant contribution to the reduction of malaria morbidity and mortality in Cambodia, especially in the remote and hard to reach (access is a problem) geographical areas that never had such in the past.

From the lesson learnt on this project is that we can bring benefit to the people who are living in remote and malaria endemic areas and there are people who could provide to the community for malaria without delay for diagnosis and Treatment/prevention too to some extent. Over a period of time if we could do such type of activities it becomes a practice where the villagers take care of their health well. In view of this the Kampot Provincial Health Director has made the request to Ministry of Health and also other Partner Agencies to build a Health Post near the Chas pagoda which is located in the centre of the commune feasible for easy access of all the people in 5 villages as their health facility.

Acknowledgments

We would like to acknowledge our sincere thanks to all the members of the study project both at National and Provincial levels especially the Project malaria workers for their effort to obtain high quality information to improve the malaria control programme and monitoring the malaria Epidemiology in Newly Developed Region in Kampot Province, Southern Cambodia with the support of the Ministry of Health, Welfare and Labor of Japan (A grant on "Research for emerging and re-emerging infections")

National Center for Parasitology, Entomology and Malaria Control in Cambodia gratefully acknowledges the funding and support the project has received from the General National Institute of Infectious Diseases, Japan.

We acknowledge with great appreciation the contribution of Project Health Workers who have become popular as VMWs for spending their valuable time to work with us in this project.
And finally thanks to all those who are involved directly and indirectly in making this project a success whose results are of use.

CNM, 22 March 2007

Approved By

Duong Socheat
Director of National Malaria Center

Reported by

Dr.Muth Sinuon

ANNUAL REPORT

(March 2006 – February 2007)

APPLICATION OF GEOGRAPHIC INFORMATION SYSTEM (GIS) IN UNDERSTANDING FACTORS AFFECTING MALARIA TRANSMISSION IN THE PHILIPPINES

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Executive Summary

Background

Malaria, and other related data, is collected in different tiers of health services, and different agencies all over the Philippines but systematic methods of analysing data, monitoring and evaluating effectiveness of disease control and predicting outbreaks are often lacking. Additionally, detailed maps of malaria distribution, in relation to other relevant variables, have not been produced and utilized. The main objective of the project is to develop RITM institutional capabilities and capacity for malaria geographic information system (GIS), and to make the information (through detailed maps) available to control program managers and to the public in general.

Methods

In the first year of the project, malaria data from previous studies conducted by the RITM, as well as malaria records from the Malaria Control Program (MCP), were collected and entered into a database constructed with epidemiological, vector, climatic and environmental parameters. Topographical and environmental maps in ArcGIS shapefile format were sourced from relevant government and non-government agencies and from published reports. Using ArcGIS (version 9.1), malaria data over a 16 year period and other related parameters were used to produce maps of malaria distribution and trends across the country for the period 1991 to 2005.

Results

Maps 1-7 show demographic, population and environmental data, while maps 8-19 show malaria distribution and trends, in relation to other variables. The maps show a general picture of declining incidence (based on number of cases reported each year) in many provinces in the country, while some others show increasing incidence, maybe due to more effective case finding and reporting systems. In general, the maps display a marked variation in malaria distribution over the years in the different endemic areas in the country. Each map is described in the report.

Conclusion

This project provides the first detailed maps of malaria distribution and trends, and in relation to other variables, in the Philippines, at spatial resolution, which may be useful to program managers and policy makers, health professionals, travellers and travel medicine professionals in their assessment of malaria risk in the country. As incidence of malaria changes over time, regular updates of these maps will be practical.

OBJECTIVES

1. To develop RITM institutional capabilities and capacity for malaria GIS.
2. To enable the tool to perform as a dynamic data reservoir concerning malaria (and other vector-borne diseases) situation in the country and factors affecting its transmission;
3. To make this information of use to malaria control policy and implementation of control strategies;
4. To make this information available to the general public through the RITM web page including downloading and uploading capacity; and
5. To develop institutional capacity for training and technology transfer.

METHODOLOGY (Activities)

1. Data sources and formats

For the first year of the study, malaria database sets were mainly collected from past and ongoing RITM malaria projects, and from the Malaria Control Program. Existing databases from the province of Palawan were also collected and used. Topographical and environmental maps in ArcGIS shapefile format were sourced out from relevant government and non-government agencies in the selected malaria endemic area (Palawan) and also from previous published reports.

Although some data were incomplete or missing, due to different data management procedures for each province, the national or provincial data on malaria consisted of the following formats:

a. Annual average number of reported malaria cases of each province per 5 years from 1990 up to 2005 - refers to the number of malaria cases diagnosed by laboratory microscopy
b. Summary and annual average number of reported malaria cases of each provinces from 1990 up to 2005
c. Total number of malaria species diagnosed of each provinces from 1990 up to 2005
d. Malaria incidence of each province for year 1990 and 2005 – refers to the number of malaria cases per 1,000 population

2. Data cleaning, checking and entry into a database

The malaria database sets were filtered for dual entries and data for patients returning within 28 days post consultation were excluded in the analysis. The filtered database sets were summarized, and whenever possible, stratified chronologically and exported into a compatible ArcGIS 9.1 application format. The exported database sets were then formatted into a 2x2 table with the spatial data (location names) entered in the *"y"* axis and the malaria data in the *"x"* axis.

During the course of data collection and analysis, some problems were encountered, including availability and reliability of database sets and reports, different formats of reporting resulting to incomplete data, and availability of most recent and updated meteorological and environmental maps. To ensure the integrity of data, quality control measures were instituted during the data filtering/cleaning and standard operating procedures (SOPs) on the processes undertaken were drafted.

3. Production of maps

Before combining with the map database to form epidemiological layers, location names of both databases were compared for dissimilarities in spelling and were corrected and updated in both directions.

The created epidemiological layers were overlaid with base layers (Figure 1 and 2) such as land coverage, elevation data, vegetation data, settlement locations, to form the completed GIS map. ESRI ArcGIS (ArcMap) version 9.1 was used to generate the maps.

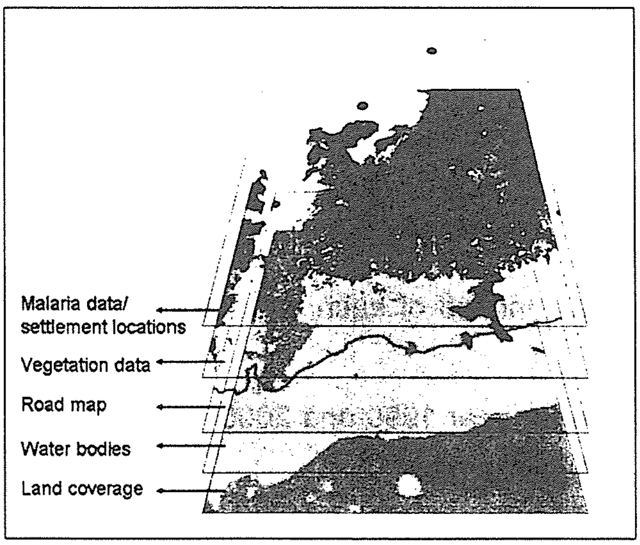


Figure1: *Geographic information system base layers*

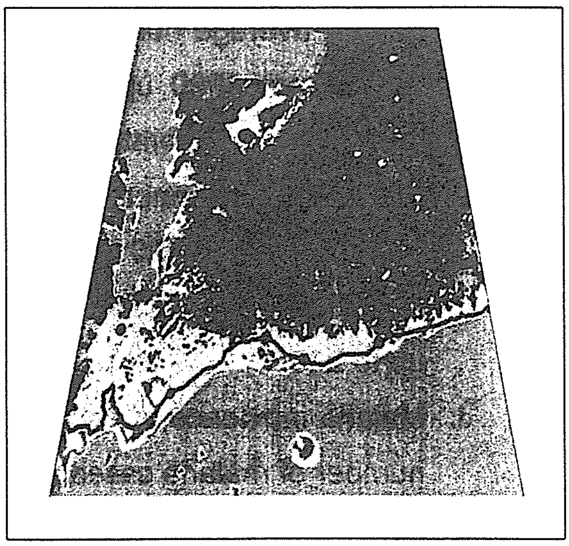


Figure 2: *Completed GIS Map*

RESULTS AND DISCUSSION

1. Philippine Population, Topography, Climate and Forest Cover

The Philippines is composed of 7,107 islands called the Philippine Archipelago, with a total land area of approximately 300,000 square kilometers or 116,000 square miles, making it the 72nd largest country by area. The country has 16 Regions, 79 provinces (NSO September 2006) and is divided into 3 main geographical areas namely Luzon, Visayas and Mindanao **(Map 1).**

Map 2 shows the total population of the Philippines according to provinces. The population count was based on population census of 2000 which ranges from 16,467 (Batanes) to 9,932,560 (Metro Manila), and with a total population count of 76,498,735. Of the 79 provinces, Metro Manila has the highest density, followed by Rizal, Laguna and Cavite. The province of Apayao and Quirino have the least population density **(Map 3).** Table 1 shows the total population and density per region.

Table 1: Population Count and Population Density per Square Kilometer According to Region, Philippines, May 2000

Region	Population	Density/Km^2
Region I: Ilocos	4,200,478	327
Region II: Cagayan Valley	2,813,159	105
Region III: Central Luzon	8,030,945	441
Region IV: Southern Tagalog	11,793,655	251
Region V: Bicol	4,674,855	265
Region VI: Western Visayas	6,208,733	307
Region VII: Central Visayas	5,701,064	381
Region VIII: Eastern Visayas	3,610,355	173
Region IX: Zamboanga Peninsula	3,091,208	193
Region X: Northern Mindanao	2,747,585	196
Region XI: Davao	5,189,335	263
Region XII: South Cotabato, North Cotabato, Sultan Kudarat, Saragangani Region (SOCCSKSARGEN)	2,598,210	179
Autonomous Region of Muslim Mindanao (ARMM)	2,412,159	211
Cordillera Administrative Region (CAR)	1,365,220	95
CARAGA	2,095,367	111
National Capital Region (NCR/Metro Manila)	9,932,560	15,617
Total	**76,498,735**	**255**

Total population and population density are important considerations in disease transmission and health service operations, particularly in relation to funding and allocation of limited resources for purposes of prioritizing areas needing the most attention. The total population suggests the quantity of people to be serviced while population density relates to the required infrastructures.

The topography of the country is extremely varied and mountainous with volcanic mountains forming most of the larger islands **(Map 4).** Mountain ranges extend from north to south, parallel to the coasts and often bordering them. The larger islands have a more diversified topography, with rivers, broad plains and level, fertile valleys in the interior. Topography plays a major part in disease transmission, difficulty in accessibility to health services and control programs leading to delayed diagnosis and treatment.

In general, the Philippines has a tropical climate (except in the higher mountains) with a mean annual temperature of 27°C (80°F) while the annual normal relative humidity averages 80%. Rainfall and seasonality are different throughout the islands **(Map 5).** Generally, the east coasts receive heavy winter rainfall and the west coasts heavy summer rainfall. Intermediate and southern areas receive low amounts of rain and are more equally distributed. Rainfall averages 2,030 millimeters annually in the lowlands. Climatic factors have a direct and indirect influence on disease transmission by sustaining or destroying the favorable conditions where the mosquito vector thrives.

The Philippines contains about 19% farmable land and 46% forests and woodlands. The forests cover almost one-half of the land area **(Map 6)**. Mangrove trees and palms (nipa) grow in coastal swamps and coarse grasses cover many areas of the uplands. Open grasslands occupy one-fourth of the land area. These grasslands were man made as result of the slash-and-burn agricultural system. Forests cover and land use plays a part on the transmission of malaria since different mosquito vectors species are found in these environments.

2. Malaria Cases and Distribution

Around 11 million people live in malaria endemic areas in the Philippines. In general, endemic areas are usually rural areas characterized by inaccessibility, inadequate or poor quality of health services and facilities as well as presence of favorable breeding sites for the anopheline vectors. Upland subsistence farmers, indigenous cultural groups, settlers in frontiers areas, seasonal migrant workers, forest product gatherers, charcoal makers, miners and soldiers are commonly affected by the disease. The National Malaria Control Program categorized the provinces based on the number of malaria cases and prioritized them accordingly (Ortega 1997).

Table 2: Classification of provinces based on number of malaria cases

Category	Description
A	Provinces with a five-year average number of more than 1,000 cases (or slightly lower), with no improvement in the malaria situation or the situation deteriorated and the geographical distribution is widespread. These provinces are given first priority.
B	Provinces with a five-year average number of cases ranging from 100 – 1,000 (or higher), with significant descending trend and foci are not as widespread as in Category "A".
C	Provinces with a five-year average number of cases which is less than 100 and the cases occur only in few isolated foci.
D	Provinces with no locally acquired cases for at least three consecutive years. Disease transmission is still a potential is some areas due to the presence of mosquito vectors.

Maps of the annual reported malaria cases from 1991- 2005 by the provinces are shown as a 5 -10 year average in the number of cases, specifically 1991-2000 and 2001-2005. **Maps 7 and 8** show the annual average number of reported malaria cases, from 1991-2000 and 2001-2005. Comparison of both maps reveal a decrease in the number of Category A provinces from 26 (1991-2000) to 9 provinces (2001-2005). This may be an indication of effective malaria control in those areas, but current available data are not sufficient to make an analysis.

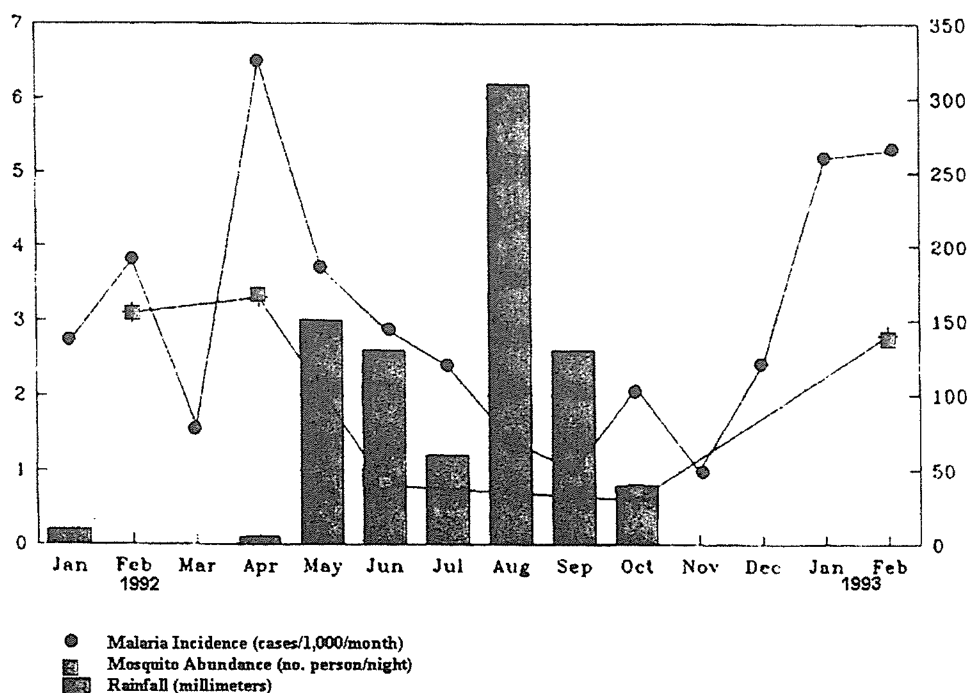
Map 9 shows the average annual reported malaria cases for the past 16 years per province (1990-2005). Generally, 8 provinces, namely: Apayao; Cagayan; Isabela; Palawan; Agusan del Sur; Davao del Sur; Sulu and Tawi-Tawi, are consistently categorized as highly endemic (based on the number of cases), in spite of extensive control efforts. Most of these provinces are located in the western part of the Philippine archipelago particularly in the island of Mindanao.

Map 10 shows the 5 year average of reported malaria cases according to provinces (from 2001-2005) overlaid with a satellite image of the country's forest cover. The number of malaria cases have a tendency to be high in provinces with dense forests while provinces with fairly forested and provinces with most of the forest cut-down for farming have fewer reported cases.

In terms of elevation, it appears that malaria cases are higher in elevated areas or mountainous areas, although this may not always be the case in the lower mountainous parts **(Map 11)** in these provinces.

As for climate, the distribution of malaria in the Philippines appears to be higher in areas receiving less than 3,000 millimeters of rain annually as shown in **Map 12**. Studies about rainfall and vector association imply that relatively wet conditions in an area can create favorable insect habitats by increasing the vector's geographic distribution and seasonal abundance. On the other hand, excessive rainfall (flooding) may sometimes wash away the breeding sites. Malaria transmission generally occurs throughout the year with peaks just after onset and at the end of the rainy season as shown in Figure 3.

Figure 3: Malaria Incidence, Mosquito Abundance and Rainfall Morong, Bataan



Torres et al., 1997

In general, *P. falciparum* infection accounts for the most number of reported cases in most of the endemic areas. **Map 13 shows** malaria species distribution by province, while **Maps 14, 15** and **16** display the distribution in relation to elevation. It appears that both species are widely distributed in the different provinces and in both lowland and upland provinces in the country.

Map 17 shows the mosquito species and their geographic distribution in the Philippines. There are five incriminated vectors of malaria in the country. Of the five species *Anopheles flavirostris* (Ludlow) is considered the primary vector based on density and epidemiological association with the disease. Reported secondary vectors include *Anopheles balabacensis* Baisas 1936, *Anopheles litoralis* King 1932, *Anopheles maculatus* Theobald 1901, *Anopheles mangyanus* Banks 1906. *Anopheles flavirostris* is distributed all over the island based on the updated (2005) distribution. Presence of other secondary vectors maybe greatly affected by several other factors as hydrology, mineral contents of soil and water, climatic types, micro environmental condition.

Old literatures showed that *Anopheles flavirostris*, the considered primary vector of malaria in the Philippines prefers to breed in partially shaded slow flowing streams commonly found in foothills and forest fringes. The same breeding preference holds true for *An mangyanus* while *An maculatus* were found to breed abundantly in sunnier parts. Though vertical distribution somehow separates one species from the other, there are certain elevations where they co-exist. Presence of vectors also varies geographically. *An litoralis* was found closest to the sea level being brackish water breeder and is reported in the island of Basilan, Sulu and Tawi Tawi. *An maculatus* was generally found at higher elevation while *An balabacensis* was mainly found in deep forests as found in Palawan. These findings however need to be updated by gathering of current indicators (water and soil characteristics, vegetation, temperature and relative humidity) that will help predict presence and abundance of each species in micro climates of each province/ island. This will verify if the existing biological characteristics earlier reported still hold true for the current species.

Another interesting concern is on the efficacy of insecticides on these anopheles vectors. Mapped out susceptibilities of vectors will help program planners implement appropriate insecticide based vector control strategies as part of control interventions. Susceptibility data will be added in the future GIS data base in selected sentinel sites in Kalinga, Palawan, Occidental Mindoro and Davao del Norte, Agusan del Sur and Isabela.

Map 18 shows the annual parasite incidence per 1,000 population (API) every 2 years from 1990 to 2004 while **Map 19** shows more recent malaria incidence report of 2005. In 1990, there were 16 provinces reporting more than 1,000 cases per year, and they were considered highly endemic. In 2004, the number of provinces was reduced to 3 provinces only, which may be an indication of effective malaria control. Again, a more in-depth analysis on this declining trend, and the factors that contributed to it, is needed. In Map 19, there is a slight increase in the number of provinces under category A (high endemic), which is probably due to improved case finding and reporting systems implemented by the Malaria Control Program and other non-government organizations involved in malaria control.

CONCLUSION

This project provides for the first time detailed maps of malaria incidence and distribution, vectors and other malaria-related parameters, in the Philippines. These maps may be useful for the planning of malaria control activities both in the national local levels (provincial and municipal). They may also be useful to health professionals, travellers and travel medicine professionals in their assessment of malaria risk in the different areas in the country. However, as incidence of malaria changes over time, regular updates of these maps are necessary to be more practical to the general public.

Other Information

Plans for the next 2 years

1. Continue data collection from selected provinces (Davao, Agusan and Apayao).

2. Upload maps in the RITM web page to make the information available to the national (and local) malaria control program, researchers and general public.

3. Conduct studies on *P. vivax* (CQ resistance, antigenic diversity and vectors), as recommended during the *P. vivax* meeting in China in January 2007. Although the current funding is for the Malaria GIS Project only, other potential funding sources and possible collaborations with Japanese institutions shall be sought.

Data and Maps Available

1. Provincial level, malaria cases 1990 – 2005
2. Provincial level, malaria species 1990 – 2005
3. Municipal and barangay level, malaria cases of Palawan 2003 – 2005
4. Municipal and barangay level, malaria species of Palawan 2003 – 2005
5. Municipal level, malaria cases Davao region 2000 – 2006
6. Municipal level. Malaria species Davao region 2000 - 2006
7. Treatment efficacy studies
8. Physical maps (contour, elevation, bathymetry, forest cover etc.)
9. Socioeconomic and demographic maps (industrial, culture, population, airports, mines etc.)

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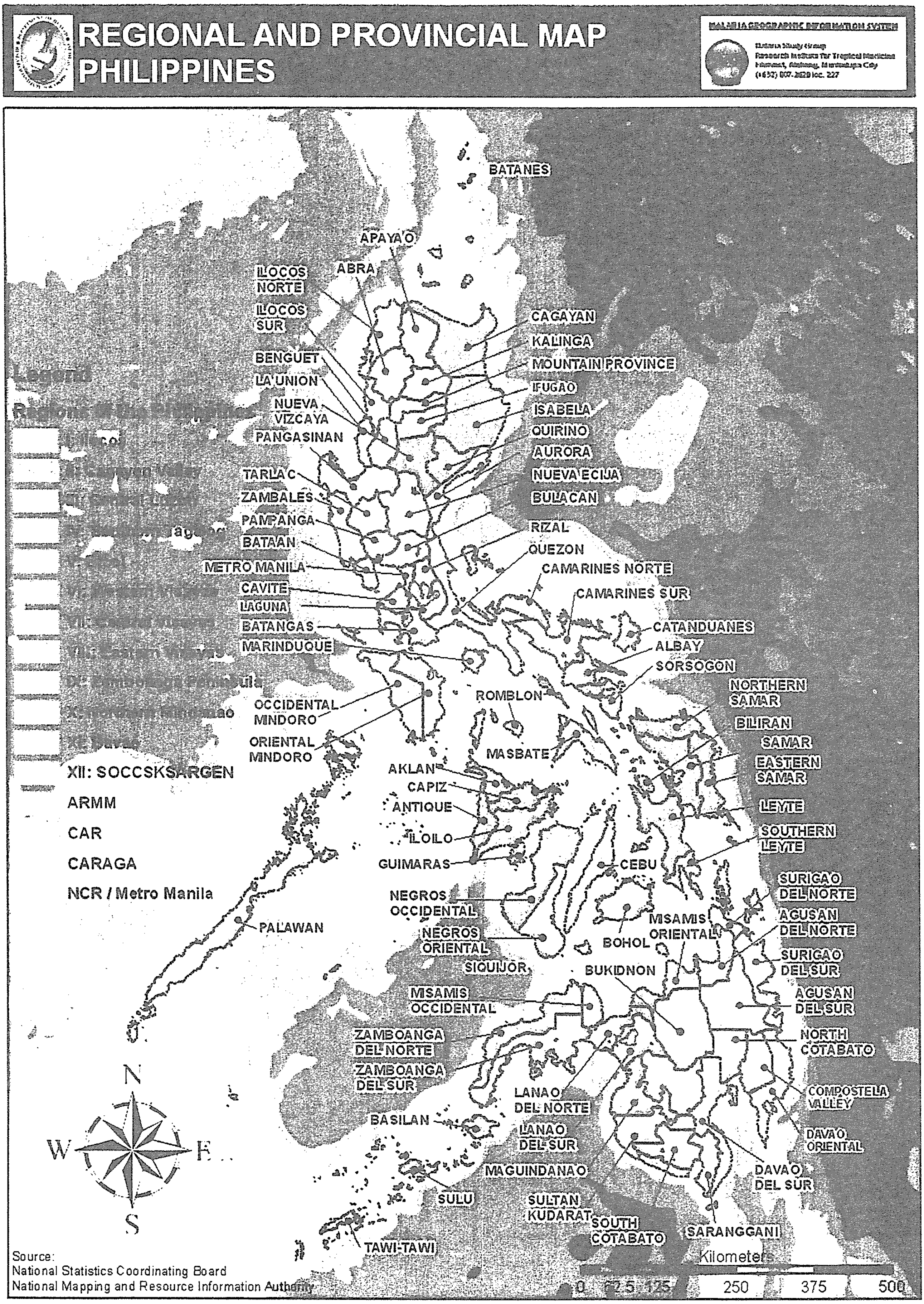
MAP 1


REGIONAL AND PROVINCIAL MAP
PHILIPPINES
BATANES
APAYAO
ILOCOS NORTE
ABRA
ILOCOS SUR
CAGAYAN
KALINGA
BENGUET
MOUNTAIN PROVINCE
LA UNION
IFUGAO
NUEVA VIZCAYA
ISABELA
PANGASINAN
QUIRINO
AURORA
TARLAC
NUEVA ECIJA
ZAMBALES
BULACAN
PAMPANGA
RIZAL
BATAAN
QUEZON
METRO MANILA
CAMARINES NORTE
CAVITE
CAMARINES SUR
LAGUNA
BATANGAS
CATANDUANES
MARINDUQUE
ALBAY
SORSOGON
NORTHERN SAMAR
OCCIDENTAL MINDORO
ROMBLON
BILIRAN
ORIENTAL MINDORO
MASBATE
SAMAR
EASTERN SAMAR
AKLAN
CAPIZ
ANTIQUE
LEYTE
ILOILO
SOUTHERN LEYTE
GUIMARAS
CEBU
NEGROS OCCIDENTAL
SURIGAO DEL NORTE
MISAMIS ORIENTAL
AGUSAN DEL NORTE
PALAWAN
NEGROS ORIENTAL
BOHOL
SIQUIJOR
BUKIDNON
SURIGAO DEL SUR
MISAMIS OCCIDENTAL
AGUSAN DEL SUR
ZAMBOANGA DEL NORTE
NORTH COTABATO
ZAMBOANGA DEL SUR
COMPOSTELA VALLEY
LANAO DEL NORTE
BASILAN
LANAO DEL SUR
DAVAO ORIENTAL
MAGUINDANAO
DAVAO DEL SUR
SULU
SULTAN KUDARAT
SOUTH COTABATO
SARANGGANI
TAWI-TAWI
Legend
XII: SOCCSKSARGEN
ARMM
CAR
CARAGA
NCR / Metro Manila
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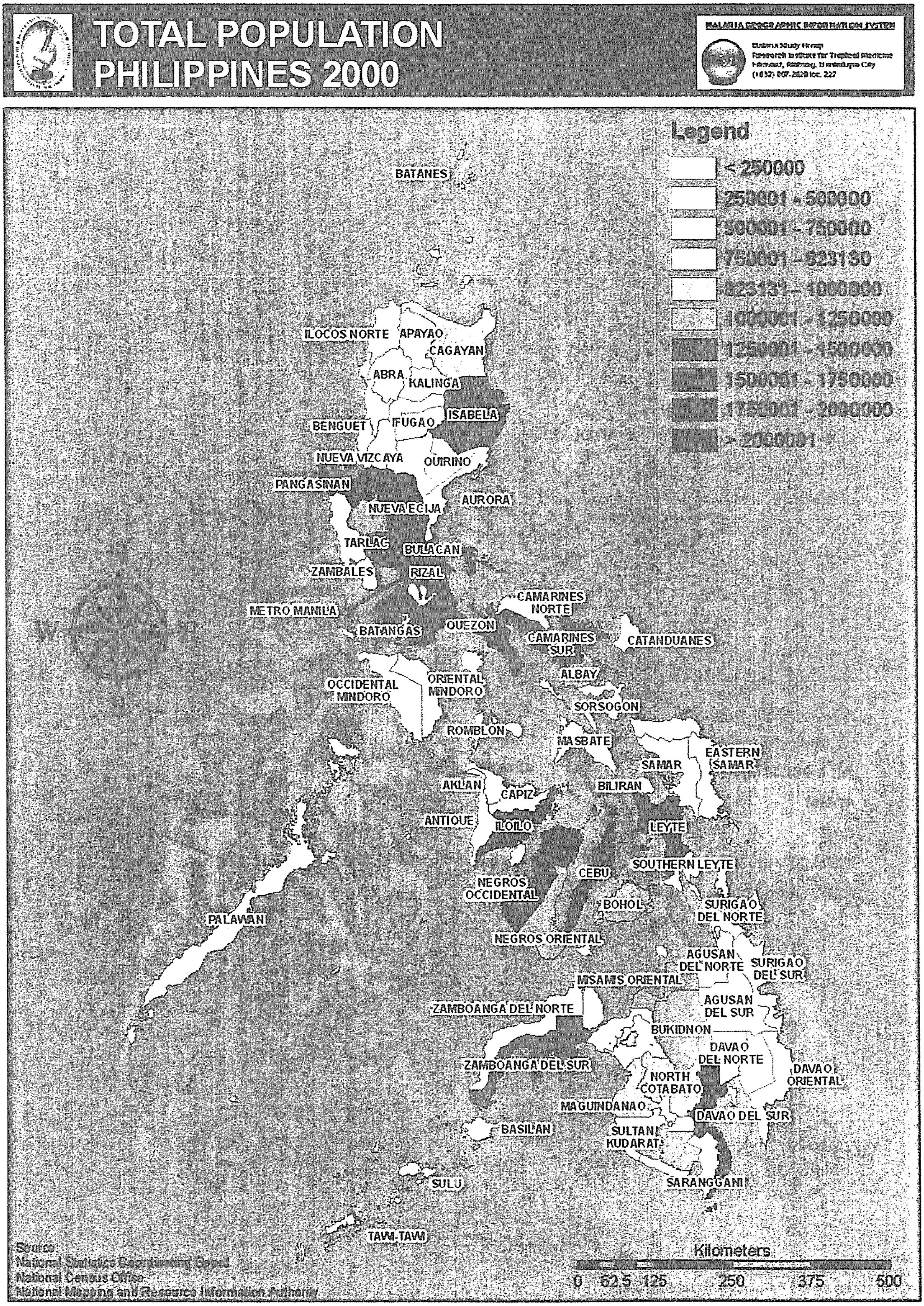
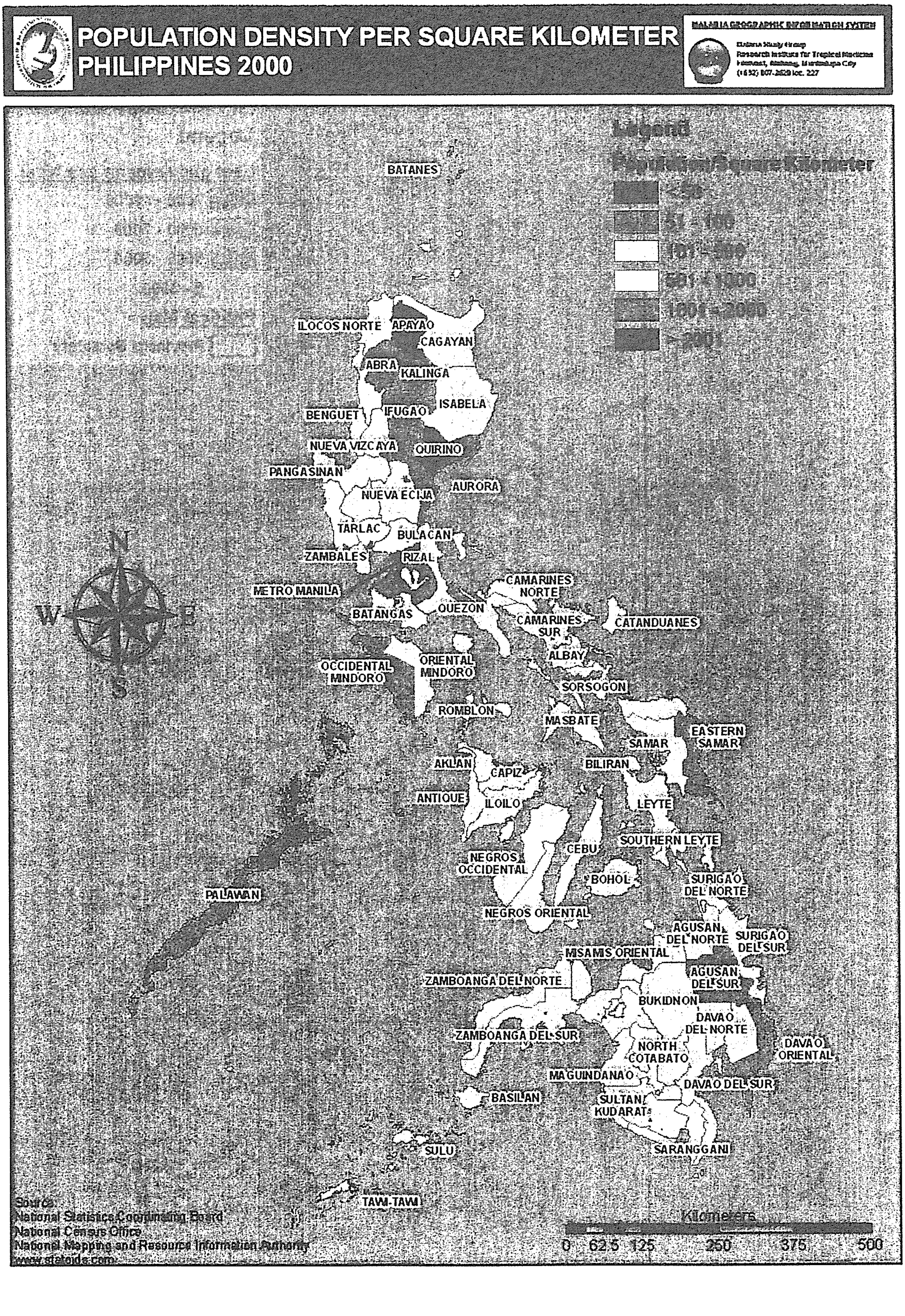
Kilometers
0 62.5 125 250 375 500
Source:
National Statistics Coordinating Board
National Mapping and Resource Information Authority

MAP 2



TOTAL POPULATION
PHILIPPINES 2000
Research Institute for Tropical Medicine
Legend
< 250000
250001 - 500000
500001 - 750000
750001 - 823130
823131 - 1000000
1000001 - 1250000
1250001 - 1500000
1500001 - 1750000
1750001 - 2000000
> 2000001
BATANES
ILOCOS NORTE
APAYAO
CAGAYAN
ABRA
KALINGA
BENGUET
IFUGAO
ISABELA
NUEVA VIZCAYA
QUIRINO
PANGASINAN
AURORA
NUEVA ECIJA
TARLAC
BULACAN
ZAMBALES
RIZAL
METRO MANILA
CAMARINES NORTE
BATANGAS
QUEZON
CAMARINES SUR
CATANDUANES
ALBAY
OCCIDENTAL MINDORO
ORIENTAL MINDORO
SORSOGON
ROMBLON
MASBATE
EASTERN SAMAR
SAMAR
AKLAN
CAPIZ
BILIRAN
ANTIQUE
ILOILO
LEYTE
SOUTHERN LEYTE
CEBU
NEGROS OCCIDENTAL
BOHOL
SURIGAO DEL NORTE
PALAWAN
NEGROS ORIENTAL
AGUSAN DEL NORTE
SURIGAO DEL SUR
MISAMIS ORIENTAL
AGUSAN DEL SUR
ZAMBOANGA DEL NORTE
BUKIDNON
DAVAO DEL NORTE
ZAMBOANGA DEL SUR
NORTH COTABATO
DAVAO ORIENTAL
MAGUINDANAO
DAVAO DEL SUR
BASILAN
SULTAN KUDARAT
SARANGGANI
SULU
TAWI-TAWI
Source:
National Statistics Coordinating Board
National Census Office
National Mapping and Resource Information Authority
Kilometers
0 62.5 125 250 375 500

MAP 3


POPULATION DENSITY PER SQUARE KILOMETER
PHILIPPINES 2000
BATANES
ILOCOS NORTE
APAYAO
CAGAYAN
ABRA
KALINGA
ISABELA
BENGUET
IFUGAO
NUEVA VIZCAYA
QUIRINO
PANGASINAN
AURORA
NUEVA ECIJA
TARLAC
BULACAN
ZAMBALES
RIZAL
METRO MANILA
CAMARINES NORTE
BATANGAS
QUEZON
CAMARINES SUR
CATANDUANES
ALBAY
OCCIDENTAL MINDORO
ORIENTAL MINDORO
SORSOGON
ROMBLON
MASBATE
EASTERN SAMAR
SAMAR
AKLAN
CAPIZ
BILIRAN
ANTIQUE
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SOUTHERN LEYTE
CEBU
NEGROS OCCIDENTAL
BOHOL
SURIGAO DEL NORTE
PALAWAN
NEGROS ORIENTAL
AGUSAN DEL NORTE
SURIGAO DEL SUR
MISAMIS ORIENTAL
AGUSAN DEL SUR
ZAMBOANGA DEL NORTE
BUKIDNON
DAVAO DEL NORTE
ZAMBOANGA DEL SUR
NORTH COTABATO
DAVAO ORIENTAL
MAGUINDANAO
DAVAO DEL SUR
BASILAN
SULTAN KUDARAT
SARANGGANI
SULU
TAWI-TAWI
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W
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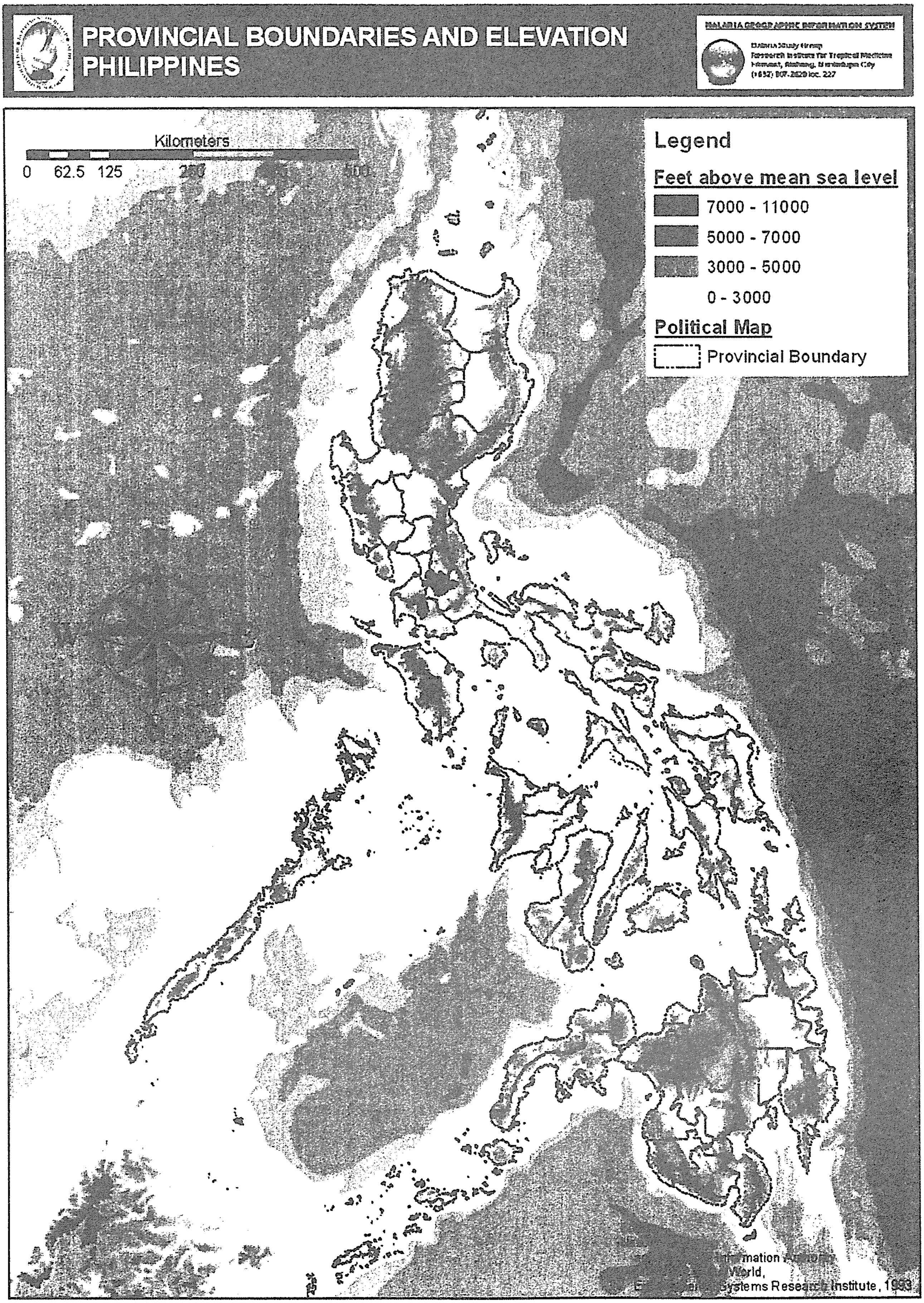
Source:
National Statistics Coordinating Board
National Census Office
National Mapping and Resource Information Authority
www.statoids.com
Kilometers
0 62.5 125 250 375 500

MAP 4


PROVINCIAL BOUNDARIES AND ELEVATION
PHILIPPINES
Kilometers
0 62.5 125
Legend
Feet above mean sea level
7000 - 11000
5000 - 7000
3000 - 5000
0 - 3000
Political Map
Provincial Boundary