Chapter 1
INTRODUCTION

1.1 Research Background

Palm is a very important plant group in Indonesia, where approximately 570 species (comprising 22% of approximately 2600 world species and belonging to 47 genera and 22 evolutionary lines) occurred in this country (Uhl and Dransfield, 1987). Yet this described species number does not include many undescribed species that we do know exist, but good fertile materials are not yet available. Undoubtedly, Indonesia possesses the largest number of palm species among any other countries in the world. Palm is a plant family of immense significance to Indonesian people, becoming the most important group just after the grasses (*Oryza* spp.) in economic importance (Dransfield, 1994). Some of the palm members are widely utilised and cultivated by the people and are available commercially, e.g. lipstick palm *Cyrtostachys renda* Blume, sugar palm *Arenga pinnata* (Wurmb) Merrill, sagu *Metroxylon sagu* Rottboel, and coconut *Cocos nucifera* L.

According to the World Conservation Monitoring Centre (1997), 31 species of the Indonesian palms (of c. 590 threatened plants) were considered as threatened with extinction. A number of unique and distinctive palms, such as *Johannesteijsmannia altifrons* (salau), *Pinanga javana* (pinang jawa), *C. renda* (linau, pinang merah), and useful rattans including *Calamus manan* (manau), *C. asperrimus*, *C. ciliaris*, *C. spectabilis*, and *Ceratolobus glaucescens* are all now facing serious conservation problems. Orchids, timbers, and palms are the top three contributors to the Indonesian threatened plants, comprising 93, 55, and 31 species, respectively (WCMC, 1997). The true number of Indonesian threatened palm species is very likely much higher than this figure. According to IUCN (2000), Malaysia, Indonesia, Brazil, and Sri Lanka are the top four countries with the largest numbers of threatened plant species, with 681, 384, 338, and 280 species respectively.

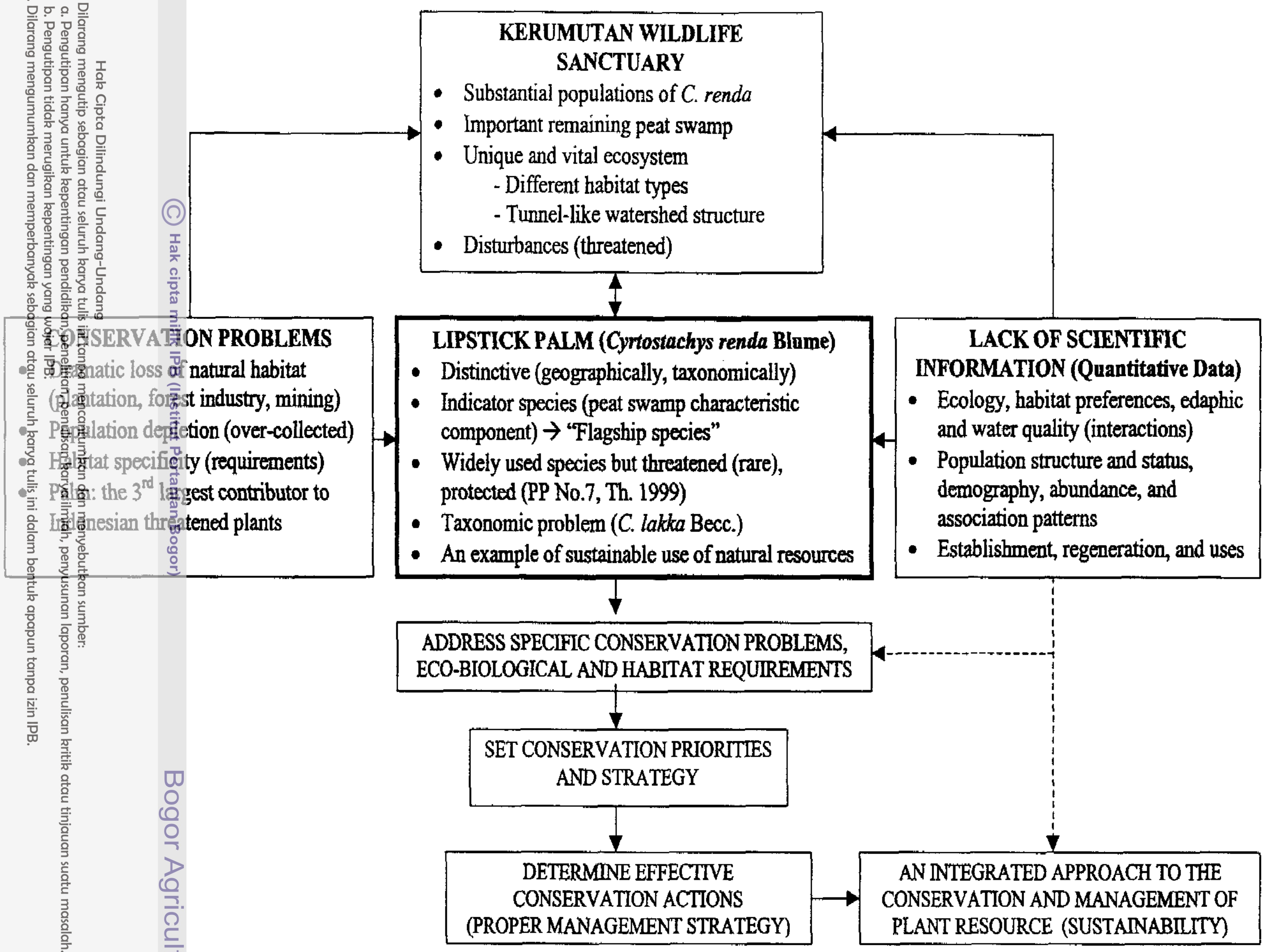

Figure 1.1 Research background.

Ironically, we still have very little information about the ecology and conservation biology and status of such species, including their ecological and habitat requirements (for establishment, recruitment, and regeneration), demography, population and taxonomic status, age structure, reproductive biology, conservation efforts, and their current and historical distribution. Yet many members of the Arecaceae family have not been clearly identified and understood ecologically, and seem to be no broad generalisations about their ecology (Moore, 1965; Uhl and Dransfield, 1987), due to the great morphological diversity which is paralleled by a wide range of their ecological adaptations and behaviour (Uhl and Dransfield, 1987). Studies conducted to gain a better understanding of which species are threatened and what driving forces causing the extinction are therefore needed to provide guidance so that conservation actions may be taken before it is too late to save them.

Cyrtostachys renda is a characteristic component (indicator species) of southeast Asian peatswamp ecosystem and an attractive subject for ecological research. From conservation point of view, this palm has a high priority as it is confined to an ecosystem that has been extensively converted into various development projects, particularly large-scale plantations, agriculture, and mining operations. This attractive species can therefore be used as a flag species to promote conservation of the peat swamp ecosystem. Yet it is the only species of the genus found to the west of Wallace's Line. The occurrence of this palm in this specific forest type is a challenging ecological aspect to investigate. The subsequent and more detail question is why this species is common in certain sites of the forest but absent from other localities of the same forest? This species appears to require precise environmental conditions for establishment, e.g. soil or habitat characteristics, moisture, interspecific association, light requirements, and nutrient availability. It may not be able to regenerate until its minimum requirements are met by the habitat conditions. Ecological information about the habitats of many palm species is by far less understood (Moore, 1979; Enright, 1985; Uhl and Dransfield, 1987). Consequently, we do not know exactly how to maintain the potential species effectively, how to address specific conservation problems, how to set conservation strategies and priorities, how to determine effective conservation actions, and thus how to use them sustainably. Studies on the autecology and conservation management of the attractive sealing wax palm are therefore required.

The lipstick palm *Cyrtostachys renda* is not only of interest from ecological and conservation points of view, but also from economical significances since this species stands to various benefits. It has been used locally, nationally, and even globally for commercial ornamental purposes. The stems are locally used for constructing pondok or bagan (floors, laths, and roofing) and logging rails. The young stem apex is often eaten by local communities providing a good source for vegetable. The hard outer wood of the stem is used for making darts (in Malaysia), while some Sumatranese believe that it has supernatural connections. Indeed, rainforest palms are greatly utilised throughout Indonesia, becoming very important commodities in various aspects of life (Dransfield, 1994). Mogea (1991) provides a list of native Indonesian palms, their uses and their conservation status, indicating the importance of this plant group for the people. Their economic importance should therefore be a strong and reasonable justification for making efforts to save as wide a range of species as possible from extinction (Dransfield, 1976; Dransfield, 1994).

For many Indonesian rural communities, the availability of wild palms to be harvested to meet their daily requirements and manufacture items that can be sold or traded for cash or goods is a vital part of their economy and crucial for their survival (Dransfield, 1994). Although some Indonesian palm use is sustainable, for example coconut and sago, many Indonesian palms are still destructively harvested. Therefore, sustained utilisation of palms and also other non-timber forest products can have significant implications for the maintenance of forest resources. However, sustainable use can be achieved if the ecology and biology of the utilised species is understood as a management basis.

Natural habitat loss and forest degradation appear to be the most serious problems to the lipstick palm. The two primary causes of habitat loss in Sumatra are plantation development (particularly oil palm, *Acacia mangium*, coconut, and sugar) and extraction activities (mainly logging, harvesting, and mining). However, developmental activities (including human settlements, industry, and the associated infrastructure, such as road constructions) also have significant impact on this species sustainability. The extant populations of *Cyrtostachys renda* in Kerumutan Wildlife Sanctuary, Riau, have become a group of the few remaining populations, while Marang forest population in Central Kalimantan only had a single individual left in the 1997 survey, due to habitat destruction and repeated forest fires. Palms of certain marginal habitats, particularly peat swamp and mangrove, are seriously threatened, and many main wetland populations have been disturbed and prevented from regenerating by habitat destruction and other human activities. As the best way to solve the problem by stopping the destruction and conversion of the habitats is not always possible, the implementation of different approaches of conservation is needed. However, to be able to provide better alternatives for conservation, knowledge and eco-biological information of the species and the habitats should be acquired first.

There are many reasons for investigating rare species and species richness. Jenkin (1981) in Batianoff and Burgess (1993) provided some examples, including the unknown importance of their ecological role, the potential unique utility as a renewable resource, the scientific significance and opportunity in answering questions, the aesthetic and psychological significance in enriching the variety and integrity of the environment, and the diversity (as this forms integrity) as an indication of our land management skills and survival abilities on this planet. Thus, a detailed knowledge of the existence of rare plants and their distribution reflects how well we know the total flora (thus their potentials) of any given area (Batianoff and Burgess, 1993). From ethical point of view, Given (1994) stated that because the extinction of rare plants is more likely than other species, we morally need to save and study them. Thus, rare species can generate a strong emotive reaction in many aspects of our life and society. They also provide strong political weight in favour of nature and wildlife conservation (Batianoff and Burgess, 1993). The discovery of a rare plant in an area is often used for strong conservation arguments. Most conservation reports highlight the importance and inclusion of the management of rare or threatened plant species, although often without reference to operative definitions of rarity (Gullan, Cheal and Walsh, 1990). Rare species are also effectively used to raise funds for conservation research and activities. However, publicised funding for rare species may preclude studies of the ecology of areas that support a diverse flora (Batianoff and Burgess, 1993). Although conservation is often associated with the management of rare or uncommon species, studies of such species should be seen as a part of the whole management of the areas.

The conservation status of most Indonesian native palm species is difficult to ascertain due to the great diversity (both floristically, geographically, and geologically, where about 570 species occur), the high rate of endemism (86.7%, based on WCMC, 1992), and the great size of the country with its numerous islands of approximately 17,000 in total (Mogea, 1991). Meanwhile, the Indonesian forests have continuously been exploited for timber, mining, and cleared for commercial plantation, agricultural development, and settlement at a greater rate than perhaps anywhere else on earth (Dransfield, 1994). For some areas, it is too late, while for some other places it is very critical, even in the case of protected areas, such as Kerumutan Wildlife Sanctuary, where forest disturbances such as logging, encroachment, and conversion continue. Yet destruction due to intentional fires (slashing and burning for plantations), especially during the dry seasons, has ever become more intense during the last ten years.

Working with rare and endangered species is faced with a daunting task (Holsinger and Gottlieb, 1991). On a global scale, the numbers of these kinds of species are even worrying. Approximately 816 of the nearly 250,000 species of vascular plants have become globally extinct since 1500 AD and a further 1,046 threatened species are thought to be at high risk in the near future (IUCN, 2000). Raven (1987) in Holsinger and Gottlieb (1991) and Bawa and Ashton (1991) estimated a figure of 60,000 threatened species in the next 50 years. The total number of 5,611 threatened species has been listed by the IUCN Species Survival Commission (2000). Many species have even been reduced to one or two populations with few individuals. For such species, determining appropriate conservation programmes, required biological information to enable these programmes to be implemented, and criteria to rank species to be conserved (prioritised) are essential. Myers (1988) in Bawa and Ashton (1991) estimates that forested areas in ten hotspot areas around the world, which contain 34,000 endemic species will be reduced to 10% of the original area during the next 20 years. *Thus the rate of extinction of plant species in the ten hotspot areas will be approximately two species per day.* Undoubtedly, the conservation of species facing with imminent extinction is a matter of high priority.

Conservation and management of threatened plants in the tropics (even in protected areas) are challenging and cumbersome tasks for a number of reasons. *Firstly*, the patterns of distribution and abundance of species in most tropical areas have not been well documented. Thus, the habitat and geographical ranges of species are poorly known. While every plant species of the British isles has been mapped on a 10 x 10 km grid in a computerised system, those of tropical areas have not been mapped even on a 100 x 100 km grid (Prince, 1984 in Bawa and Ashton, 1991). *Secondly*, large proportion of species have been found to be rare, in the sense that they occur in very low population densities. Yet the number of species per unit area is very large and new species continue to be discovered. *Thirdly*, almost all tropical plants occur in complex interactions or associations to complete phases of their life history cycle. For example, association with mycorrhizae for establishment, pollination and seed dispersal by a wide variety of animals, and mutualistic interaction with other plant species in the community. Thus, conservation of tropical plants must take into account a variety of other plant and animal species with which they interact directly or indirectly. *Finally*, information on population genetic structure, which is essential to the design of appropriate conservation strategies, is poorly developed for most tropical forest plant species. Together with unique biological features of tropical forest plants and the threats of imminent extinction make the problem of conserving tropical plant species more complex (Bawa and Ashton, 1991).

Although the palmae family are relatively well known taxonomically, diversity and geographic information and variation at the specific level of palms are less well understood, due to the fact that in the past, species were frequently described from fragmentary specimens that are difficult to compare with the more complete specimens of modern collectors. Even in the case of *Cyrtostachys renda* Blume and *C. lakka* Becc., there are still some taxonomic problems and confusion that need to be clarified. Difficulties in collecting palm specimens, due to their large sizes and for many species often with arms (spines), lead many botanists to leave them uncollectedly (Moore, 1979). As a consequence, the endangerment at the specific level is difficult to assess, and only very little history of many species is known which is insufficient to understand the sequence of events that have led to the scarcity of the species at present time. Indonesian situation is a good example of these phenomena and *Cyrtostachys renda* does represent the typical situation. Only very few specimens of this species are available in the Herbarium Bogoriense, Kew Herbarium, and Leiden Herbarium. Because more than one-third of palm species are monotypic and nearly half of the genera only have very few species, the endangerment of palms is indeed an important aspect in plant conservation (Moore, 1979). The taxonomic distinctiveness of the lipstick palm is one of the most significant factors to consider in evaluating the relative importance of the taxon for conservation. Taxonomic distinctiveness is a useful criterion because it is the simpliest and most accessible estimator of the extent of evolutionary divergence.

Since 1970's rare plant research has focused on providing information on the synecological relationships and distribution of endangered populations, while rare or threatened species management requires quantitative and autecological data and information that can readily be generated from field monitoring programmes (Pavlik, 1986 in Elias, 1986). Although synecological study has benefitted from the standardisation of survey and documentation techniques, which is allowing the development of reliable data bases for identifying and protecting threatened taxa as well as the establishment of nature reserves worldwide for rare plants and animals, it does not ensure the persistence of rare threatened populations (Barkley, 1981; Nelson, 1984). Once an area protected from human disturbance, such populations must be properly managed to some extent in order to survive and reverse their decline. The ecology of species can effectively be applied to address specific conservation problems, set conservation priorities, and subsequently determine conservation actions accurately. Any conservation strategy will require available autecological information. Autecological research can further be used for developing a framework for standardising monitoring programmes and an essential approach for managing threatened species (Pavlik, 1986 in Elias, 1986).

Two fields of autecological investigation have been recognised: *population structure and demography*, and *physiological ecology* (Pavlik, 1986 in Elias, 1986). This research focuses on the former study, particularly on the documentation of population structure and trends, including population status (abundance), age structure, growth, survivorship, seed germination and seedling establishment, vegetative segmentation, spatial distribution, establishment, and relationships among relevant parameters. Survivorship, seed production and germination (or vegetative segmentation) are very important elements in the demographic study due to their obvious relation to rare plant conservation. According to Begon and Mortimer (1981) and Hutchings (1986), these data were also vital in constructing life table and estimating net reproductive rate (R_o). They proposed a formula of $R_o = \Sigma\, l_x\, m_x$, where R_o is an estimate of the number of new individuals produced by each plant under the environmental conditions found within the population, l_x is the probability of a seed (an individual) germinating or surviving from day x to day x', and m_x is the average number of seeds produced per individual during the interval x' – x. The product of these variables is calculated for each time interval during the life of a cohort (each stage in the life cycle, e.g. seed, sucker or seedling, or juvenile) and then summed. R_0 greater than 1.0 indicates that the population is growing, while that of less than 1.0 indicating a declining population. However, problems associated with determining survivorship within seed cohorts are often encountered particularly between seed dispersal and germination. To solve this difficulty, efforts need to be made, e.g. by conducting an artificial seed germination. In a situation where life tables are not possible to construct, survivorship, vegetative segmentation or seed production data can still be utilised to predict population trends and identify the factors that contribute to population instability or decline (Pavlik and Barbour, 1986 in Elias, 1986).

In comparison with ecosystem or landscape conservation, species-based conservation has so far been regarded as "a minor, not preferable, conservation approach". *The tendency among some conservationists and ecologists to dichotomise nature into species and ecosystem has led to confusion and much debate.* Many scientists and professionals who dedicate their professionalism on species-based studies will be characterised as "bad guys", while the ecosystem or landscape ecologists, who argue a more holistic conservation strategy will be called "the heroes". Species-based enthusiasts are often critisized due to their preference to distinctive, charismatic, spectacular, large (e.g. valuable timbers), or keystone species, leaving little or nothing for less spectacular creatures. On the other hand, the ecosystem-based supporters argue that they favor a habitat approach, based on (1) the identification, classification, and protection of representative samples of all biotic communities, and (2) the management of these protected areas at the appropriate physical and temporal scales. Salwasser (1991) in Soule and Mills (1992) stated that species approach to conservation is a crisis management approach. However, consider the data on the Indonesian threatened plants (IUCN, 2000) on which there are 590 officially listed threatened species (it means a significant increase if compared with 562 records officially listed by WCMC, 1996), and none of which has recovery plans or conservation action strategy, attention on such species is crucial. Recovery plans or conservation strategy will enable to establish the criteria for recovery and recommend the management options and may be interventions that should be implemented for priority species. Therefore, in order to be effective species-based conservation approach should be able to identify habitat and ecological requirements, population status, viable populations, association, distribution, minimum number of sites or areas in which priority species can be conserved, and other important biological aspects of species studied, and counteract the causes that lead to the species crises. Species-based approaches should therefore not merely be dealing with spectacular and large species.

There should be no conflict between species-based and ecosystem-based conservation approach. For example, assessment of impacts at the ecosystem level will certainly depend on the monitoring and investigation of individual species (Van Horne, 1983 in Soule and Mills, 1992). Species-based approaches can greatly assist the identification of conservation-worthy areas and biodiversity (Maddock and Du Plessis, 1999). Thus, the conservation of species requires attention to habitat conditions, ecosystem processes, and disturbance dynamics. In practice, ecosystem approach can not always be implemented and maintained for long-terms, particularly in developing countries where the rates of land conversion are very high. Together with the lack of law enforcement and commitment to conservation, the persistence of natural habitats for a long run can not be guaranteed. Thus, the increasing rate of protected area or habitat failure needs a backup system which is more secure, even if it is less natural, e.g. in the shape of *ex situ* management. Ecosystem management must also attend to the viability of critical species, even if they are not yet threatened (Soule and Mills, 1992).

Indicator species are very important in the study and management of natural ecosystems, and the types of habitats or ecosystems are generally characterised by such species. By studying the spatial requirements of these strongly interacting species, the approximate amount and criteria of area needed to prevent the loss of certain biological diversity can partly be identified. For example, if a species is determined to be important in the long-term maintenance of habitat diversity and characteristics, special attention must be given to the requirements and viability of its populations within the system (e.g. protected area). Clearly, system viability cannot be disassociated from species viability. The design and management of conservation areas will rarely succeed without attending to the requirements, monitoring, and study of problem species. Thus, the species versus ecosystem dichotomy in biology is fatally flawed conceptually and operationally (Soule and Mills, 1992). A conservation strategy that ignores anything except species is absurd and a pure species approach is just as contradictory as a pure ecosystem approach. Rather, the combination and complementarity of the two approaches may lead to new, synthetic approaches.

This study applies an integrated species-based conservation approach (Fig. 1.2) as a complementary tool of the 2000 Management Plan of Kerumutan Sanctuary. Approaches integrating ecological, physical, and socio-economic aspects are indeed required for developing strategies for sustainable management of natural resources (Stenseth and NINA, 1992). Such approaches are important not only to enable us to implement a desired procedure and mechanism into the developed systems (e.g. protected areas) but also to design how we should manage our resources better than is done today. However, difficulties of conducting interdisciplinary works are obvious, for example, subjects or fields involved (e.g. natural and social aspects) need to be investigated on an equal basis. Commonly, a group of scientiests working closely together, but this way often results in biased analyses, or bias to one or the other field, and is costly. Alternatively, the scientiest carries out the integrated research him/herself. This means that the scientiest should be trained in (or familiar with) both fields.

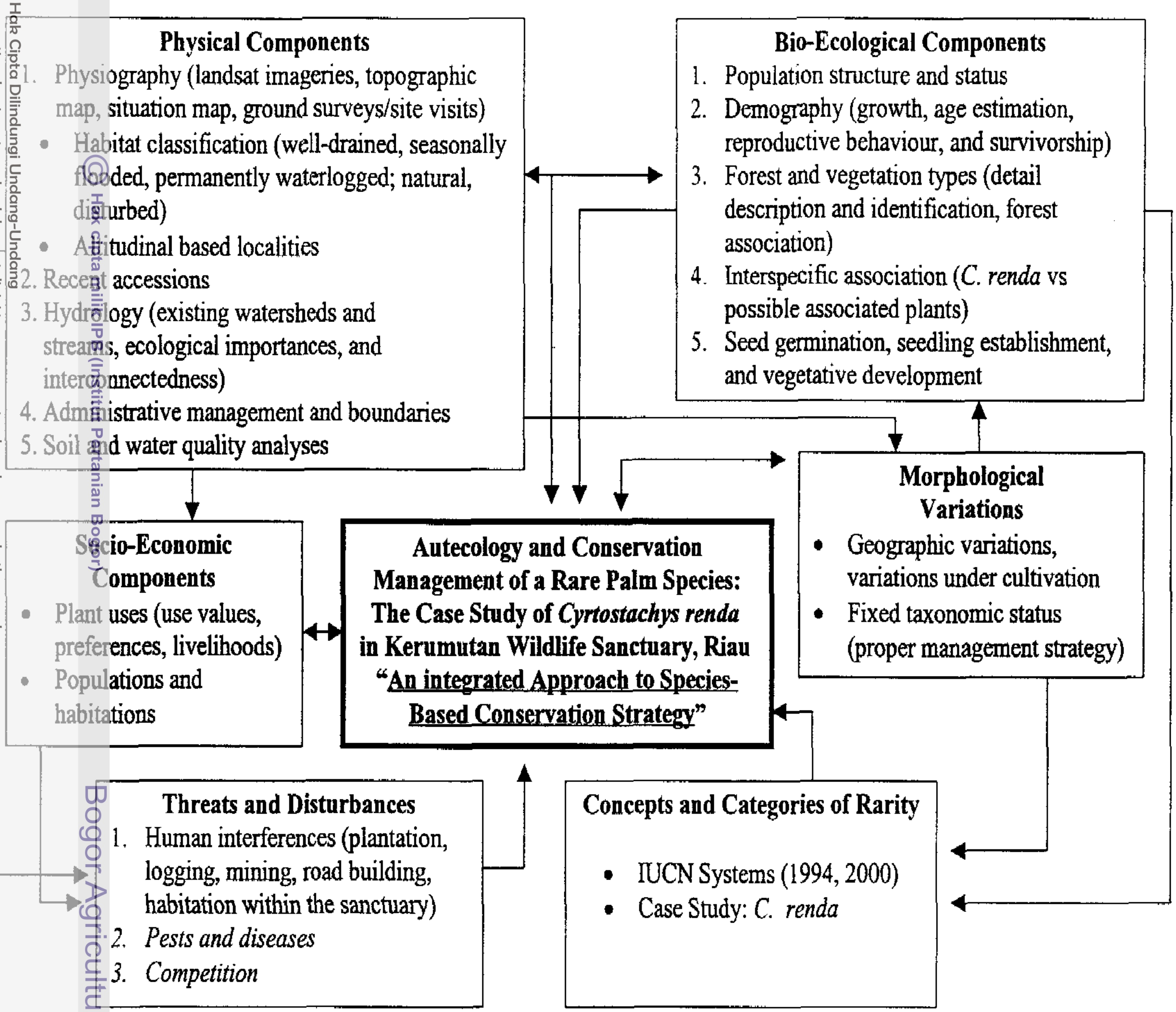

Fig. 1.2 An Integrated Approach to Species-Based Conservation Strategy (The Case Study of *Cyrtostachys renda*).

Kerumutan Wildlife Sanctuary, Riau, Sumatra was chosen as the focus of the study for a number of reasons. It is one of the most important peat swamps in Indonesia, where substantial populations of *Cyrtostachys renda* occur (natural regeneration continues and a complete range of age and size classes can be found), only very little research has been done (thus lack of scientific knowledge), consisting of different habitat and forest types, and containing many unique and interesting plants and animals. In some localities, the palm populations are abundant becoming a significant element of the vegetation and some successful recruitment occurs. All of these allow a full autecological study to be conducted. However, the sanctuary is facing with various forest disturbances and encroachment, including timber exploitation (meranti, ramin, and punak), stealing of forest and river resources, plantation development (rubber, oil palm, and *Acacia mangium*), resettlement, and road construction. The road construction was initiated in June 2000 and would pass through the northern area of the sanctuary where the largest population occurs. Some localities adjacent to the reserve border have ever been totally converted into oil palm and rubber plantations and settlements, particularly western and northern sites. All of these affect the sustainability of this rare species and the destruction of a large proportion of the sanctuary continues during the study. Thus, social aspect and human interference focusing on the uses of the palm species by the local communities is an important aspect to investigate.

Kerumutan peatswamp and the adjacent watershed is an important wetland in Sumatra and has vital functions in the regulation of local and regional hidrology, maintenance of biodiversity, source of renewable bioresources, providing a habitat for various protected plant and animal species, and as a buffer ecosystem (between salt and fresh water). Kerumutan River is the upper reach of a very long watershed flowing through Kampar River which ends up in the estuary in Panjang Strait. This tunnel-like watershed structure creates Kerumutan watershed as the tip of a tidal bore influenced inland area (Fig. 3.1). Such a unique ecosystem may contain unique life patterns, e.g. phytosociology, population dynamic, and association. Unfortunately, the upper parts of the watercourse have been almost completely converted into plantation, mining area, and settlement. This dramatic change would affect the ecosystem dynamics and sustainability of particularly the lower reach biota of the watershed.

Up to the year 1999, there are 18 conservation areas in Riau, comprising a 541,129.77 hectare area, thus only covers around 5.7 per cent of the total province's area, or approximately 11.1 per cent of the actual Riau's remaining forest. They consist of 10 wildlife sanctuaries (*suaka margasatwa*), two nature reserves (*cagar alam*), two recreation areas (*hutan wisata*), one hunting park (*taman buru*), one grand forest park (*taman hutan raya*), one national park (*taman nasional*), and one elephant training centre (*pusat latihan gajah*). Of these, wildlife sanctuaries represent the largest category, covering an area of 391,291.95 ha (88% of the total province conservation area). Kerumutan Wildlife Sanctuary is the second largest protected area in the province, just after Bukit Rimbang/Bukit Baling Wildlife Sanctuary (136,000 ha, Table 1.1). The potentials and natural history of nearly all Riau's protected areas are very little known (SBKSDA Riau, 1999). The Province of Riau includes a total area of about 9.46 million hectares (with an actual area of remaining forest is estimated to be about 4.87 million ha or 51.5%); 4.5 million ha (47.6%) and 0.52 million ha (5.5%) of which consist of peat swamp and fresh water swamp area, respectively. From the total 7.28 million ha of Sumatran peat swamp area, 4.5 million ha (61.8%) of that occurs in Riau, while from the total 4.91 million ha of the island freshwater swamp, 0.52 million ha (10.6%) of that also occurs in the province. Thus, Riau has the largest peat swamp and the third largest freshwater swamp area in Sumatra (Whitten *et al.*, 1987; BAPPEDA Riau and BAKOSURTANAL, 1998; *data analysed*).

Table 1.1 Conservation (protected) areas in Riau in 1999.

No	Category / Name	Area Established
1	Kerumutan Wildlife Sanctuary	120,000 ha
2	Danau Pulau Besar/Danau Bawah Wildlife Sanctuary	28,237.95 ha
3	Tasik Tanjung Padang Wildlife Sanctuary	4,925 ha
4	Tasik Belat Wildlife Sanctuary	2,529 ha
5	Bukit Batu Wildlife Sanctuary	21,500 ha
6	Balai Raja Wildlife Sanctuary	18,000 ha
7	Giam Siak Kecil Wildlife Sanctuary	50,000 ha
8	Bukit Rimbang/Bukit Baling Wildlife Sanctuary	136,000 ha
9	Tasik Besar/Tasik Metas Wildlife Sanctuary	3,200 ha
10	Tasik Serkap/Tasik Sarang Burung Wildlife Sanctuary	6,900 ha
11	Pulau Berkey Nature Reserve	559,60 ha
12	Bukit Bungkuk Nature Reserve	20,000 ha
13	Sungai Dumai Recreation Area	4,721.60 ha
14	Muka Kuning Recreation Area	2,065.62 ha
15	Pulau Rempang Hunting Park	16,000 ha
16	Sultan Syarif Hasyim Grand Forest Park	5,920 ha
17	Sebanga Duri – Riau Elephant Training Centre	5,873 ha
18	Bukit Tigapuluh National Park	94,698 ha*
	TOTAL	541,129.77 ha

Source: Sub Balai Konservasi Sumberdaya Alam, Riau (1999).
*The remainder 33,000 ha of this national park is located in Jambi Province.

1.2 Aims

The aims of the research are:

1. to construct an integrated approach combining eco-biological, physical, and socio-economic aspects for developing an effective conservation strategy for sustainable management and use of plant resource, with special reference to the lipstick palm *Cyrtostachys renda*;
2. to analyse morphological characters and variations within *Cyrtostachys renda* Blume and *C. lakka* Becc. in order to provide a better (fixed) taxonomic status of the 'two species' and thus a proper conservation strategy;
3. to understand the interaction between the palm and its environmental conditions (physical, chemical, and biological parameters), including specific ecological requirements, habitat specificity, forest and interspecific

associations, germination, growth and population establishment for determining the appropriate conservation management;

4. to assess the population structure, status, and demography (including reproductive behaviour and survivorship) of the species in Kerumutan Wildlife Sanctuary based on quantitative data for better conservation management decisions;
5. to investigate the potential uses and preference of the rare species by the local communities in conjunction with its autecological and conservation implications.

1.3 Hypotheses

1. There are no significant differences in the morphological characters (variations) between the Sumatran representative *Cyrtostachys renda* and the Bornean native *C. lakka*.
2. *Cyrtostachys renda* has specific ecological and habitat requirements (characteristics) so we need to conduct an appropriate conservation and management strategy for this species.

1.4 Expected Results

1. Comprehensive and detail information about the autecology of *Cyrtostachys renda* to prepare its conservation management strategy.
2. An integrated approach to the study and conservation of plant species (particularly *C. renda*) as a scientific basis for conserving and managing Indonesian threatened plant species sustainably.