VASCULAR PLANT DIVERSITY OF MANGROVE FOREST IN DONG LONG COMMUNE, TIEN HAI DISTRICT, THAI BINH PROVINCE

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Mangrove forests play an important ecological role in the coastal environment. They not only prevent erosion of dykes from waves and storms by stabilizing sediments with their tangled root systems, but also maintain water quality and reduce pollution, as well as provide the sea foods for human beings (Phan & Hoang, 1993; Phan, 1999).

Dong Long commune belongs to Tien Hai district, Thai Binh province. It has a total area of 7.83 km^2 and has a total population of 5010 people (; Phan, 1999). This is one of 4 (of 34 communies and 1 town) communes in Tien Hai district with relatively large mangrove forests. Last some years, due to the development of extensive shrimp farms, mangrove forest areas shrunk and the vegetation were degraded. That is why many coastal dyke systems in Dong Long commune were eroded and broken when a storm came. To support the restoration and development of mangrove forest, we need to determine the composition of plant species, their association, communities, and their distribution in mangrove forest. From that, we gain an overview about the rules of changing in the structure of mangrove forests and also mangrove forest succession. This is the basictechnical solution to develop mangrove community hererin.

I. METHODS

1. Objects

Vascular plant species and plant communities in mangrove forest in Dong Long commune, Tien Hai district, Thai Binh province.

2. Methods

- Field survey: Investigation by survey lines and sample plots (cited by Nguyen Van Chung, 2014). On each survey line, 3 typical locations is selected and distance from sea to dike is about 50 m, 150 m and 250 m to set up 3 plots (Plot 03; Plot 02; Plot 01) and each plot has an area with 500 m^2 (20 m x 25 m) as Fig.1. All data were collected according to Nguyễn Nghĩa Thìn (2007) and Hoàng Chung (1980).

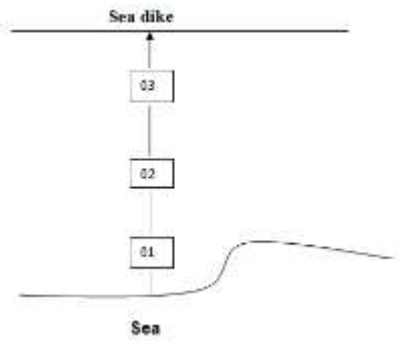

Fig. 1**: Sample plots are set up on survey line**

- Data analysis: Identification was based on Pham (1999-2003) and Nguyen (1996); Assessment of plant diversity by Nguyễn Nghĩa Thìn (2007), Hoàng Chung (1980), and Ministry of Agriculture and Rural Development (2000); Description on community was based on Thái Văn Trừng (2000); Predict plant succession by Vũ Trung Tạng (2009).

II. RESULTS AND DISCUSSION

1. Species composition of vascular plants in Dong Long commune

A total 51 vascular plant species were identified, belonging to 49 genera, 13 families of 2 phyla: Polypodiophyta, Magnoliophyta, of which 05 species are true mangrove plants, 17 species of mangrove associated plants and 29 species of immigrant local plants (according to the division of Phan N.H., 1999). 05 true mangrove plants and their distribution according to 03 lines are detailed in Table 1.

Table 1

True mangrove species in 3 lines

Scientific name	Vietnamses name	Survey lines		
		Line 1	Line 2	Line 3
Sonneratia caseolaris	Bần chua	+++	++	+
Kandelia candel	Trang	+	+++	++
Aegiceras corniculatum	Sú	0	++	+++
Acanthus ebrateatus	Ô rô	+	+	++
Rhizophora stylosa	Đước vòi	0	+	0

Note: 0 absent; + rare; ++ average; +++ abundant

As above table, we recognize that *Sonneratia caseolaris*, *Kandelia candel* and *Acanthus ebrateatus* distribute at all three lines, and *Rhizophora stylosa* just appears at only one line (Line 1). *Aegiceras corniculatum* appears in two lines. So 4 species - *Sonneratia caseolaris*, *Kandelia candel*, *Acanthus ebrateatus* and *Aegiceras corniculatum* are plants adapting with natural condition in Dong Long commune.

2. Life form diversity

Beside true mangrove species, Dong Long also has associated and immigrant local species. They created an ecosystem with many different structure and life form. 4 life forms of plants were divided into wood, shurb, herb and liana (Ministry of Agriculture and Rural Development, 2000) shown in Table 2.

Table 2

The life form of mangrove vegetation in Dong Long

No.	Life form	Symbol	No. of species	Rate (%)
1	Wood	W	11	21.6
2	Shrubs	S	16	31.4
3	Lianas	L	2	3.9
4	Herbs	H	22	43.1
	Total		**51**	**100**

Result shows that the life form having highest rate is herb, accounting for 43.1% of total species. The main species belong to Asteraceae family and Amaryllidaceae family and they usually live in dyke edge, coastal shrimp farms and road. Shrubs group accounting for 31.4%.

The main shrub groups are species as *Aegiceras corniculatum*, *Acanthus ebrateatus*, *Clerodendrum inerme* and some species belong to Solanaceae family. Wood life forms account for 21.6% after herb and shrub groups and main species belong to True mangrove species as *Sonneratia caseolaris*, *Kandelia candel*, *Excoecaria agallocha* (Giá) and Mangrove associated species like *Hibiscus tilliaceus* (Tra làm chiếu). Liana just accounts for 3.9% includes *Ipomaea pes-carpae* and *Canavalia lineate.*

3. The valueable uses of vegetation

The research results have identified that mangrove vegetation in Dong Long have 50 species and all of them have valuable use such as: medicical, food, timber and firewood, bonsai, food, attar (Ministry of Agriculture and Rural Development, 2000) (Table 3).

The result shows that the number of plant turns used in medicine is largest at 86.3% and the majority belongs to herbs and shrubs life forms and they usually distribute around dyke and highland. Bonsai and food values account for 21.6% and timber, firewood accounts for 17.6%. Others value just account for from 6 to 12%.

Table 3

The valuable uses of vegetation in Dong Long

No.	Valuable uses	Sign	Number of species turns	Rate (%)
1	Medical	M	44	86.3
2	Timber, firewood	TF	9	17.6
3	Bonsai	B	11	21.6
4	Food	F	11	21.6
5	Tamin, Attar (tinh dầu), dye (thuốc nhuộm)	A	6	11.8
6	Toxic	T	3	5.9
7	Differences (fibre, beekeeping)	D	3	5.9

4. Species density

Forest density is important factor impacting to forest formation and living space potential of site conditions. In the entire process of formation, growth and development of the forest, the density is constantly changing factors. Through investigation on structure density of mangroves in research area, the results are summarized in the Table 4.

Table 4

Tree density in communities, assemblages in Dong Long commune

Communities	**Plots**	**Density**	
		Trees/plots	**Trees/ha**
Sc- Kc- Ae	1	23	460
	2	72	1440
	3	93	1860
	Average	**63**	**1253**
Ae- Ac- Sc	4	262	5240

	5	212	4240
	6	63	1260
	Average	**179**	**3580**
Ac- Kc- Ae- Sc	7	242	4840
	8	354	7080
	9	183	3660
	Average	**259**	**5193**

Community Ac- Kc- Ae- Sc (Sú - Trang - Ô rô - Bần chua) has high density with 5193 trees/ha, almost *Aegiceras corniculatum* (Sú) in this community are trees that grow many sterms and grow quite thick, so it makes the number of trees in plot is superior than other plots. However, Community Sc- Kc- Ae (Bần chua - Trang - Ô rô) and plot 06 in community Ae- Ac- Sc (Ô rô- Sú- Bần chua) have low density and the dominant species is *Sonneratia caseolaris* (Bần chua). This can be explained by the species *Sonneratia caseolaris*are the largest size species in mangrove species here, so its presence has limited the presence of other species because they occupy a lagre space nutrition considerable support.

5. Community structure (Fig. 2, 3, 4)

The research concentrates on stratified structure with forest separation into different tree layers following to vertical section and cross section. In three mangrove communities in Dong Long commune, tree component participating in mangrove forest is less, species composition is relatively simple, so stratified structure in here is also simple.

Sonneratia caseolaris - Kandelia candel - Acanthus ebrateatus community: A stratified property of this community is quite clear. Community includes 2 main species are *Sonneratia caseolaris* and *Kandelia candel;* the structure includes 2 distinctive layers. *Sonneratia caseolaris*has biggest size and highest in mangrove forest, so *Sonneratia caseolaris*is high layer in this community with 7.8 m in average height and 28 cm in average diameter. *Kandelia candel* is in second layer with 1.6 m in average height and 4 cm in average diameter.

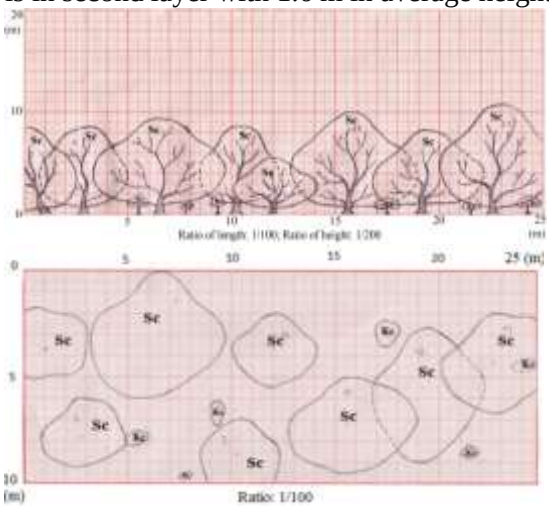

Fig.2: **Vertical profile (above) and Cross profile (below) in line 1**

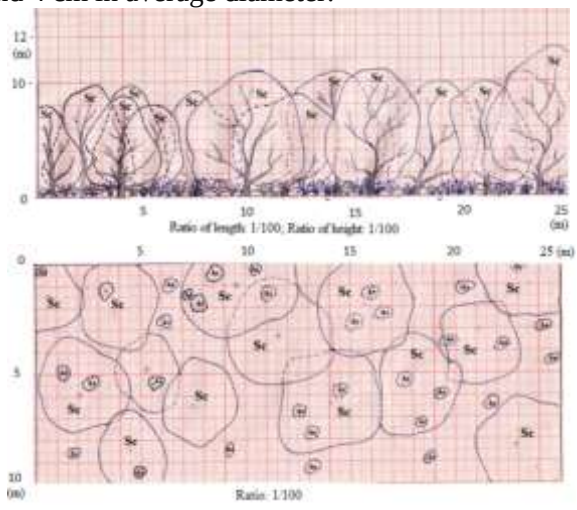

Fig.3: **Vertical profile (above) and Cross profile (below) in line 2**

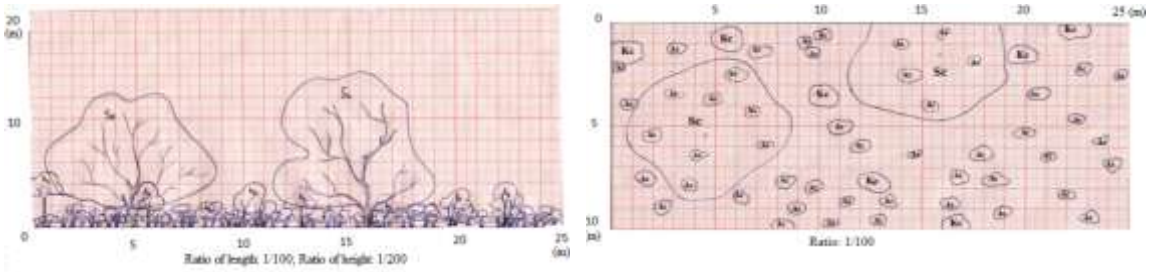

Fig.4: **Vertical profile (left) and Cross profile (right) in line 3**

*Acanthus ebrateatus - Aegiceras corniculatum - Sonneratia caseolaris*community: A stratified property of this community isclear. Community includes 2 main species are *Sonneratia caseolaris, Acanthus ebrateatus* and *Aegiceras corniculatum.* High layer is *Sonneratia caseolaris,* average height is 10 m and average diameter is 25.5 cm. The second layer includes *Acanthus ebrateatus* and *Aegiceras corniculatum*. They belong to shrub and have nearly same in height about 1.2 m.

Aegiceras corniculatum - Kandelia candel - Acanthus ebrateatus - Sonneratia caseolaris community: A stratified property of this community is quite clear. There are three layers in this community. The highest layer is still *Sonneratia caseolaris* with average height of 13.3 m and diameter of 39 cm. The second layer is *Kandelia candel,* average height of 3.9 m and average diameter of 9.6 cm. The third layer includes *Aegiceras corniculatum* and *Acanthus ebrateatus*, and both of them have nearly same in average height of 1.5 m.

In summary, Dong Long commune appears 3 mangrove plant communities with simple species composition (just mention to true mangrove group). The typical species in group are *Sonneratia caseolaris, Kandelia candel, Acanthus ebrateatus* and *Aegiceras corniculatum*. Especially *Sonneratia caseolaris* is dominant species appearing in 3 communities and 3 plots.

6. Predict plant succession in Dong Long

Plant succession is the process by which one ecosystem is replaced by another one. There are many kinds of succession. However, based on researching mangrove succession in tropical estuaries Southern of Vũ Trung Tạng (2009), we can determine mangrove succession process at study site is primary succession.

Through species composition and the number of mangrove species distributed in plots from seaside to dyke, we can see that the number of mangrove distribute unequally. The pioneer begins with low density in estuary, developts into forest with high density in regular intertidal zone and low density from irregular intertidal zone to dike edge. Therefore, we can divide succession into 3 stages: pioneer, mixed community and degradation. In estuary, slush is not suitable for life of many tree species; *Sonneratia caseolaris, Aegiceras corniculatum* are the only pioneer species living here. Because they are able to stands a high salinity, wave and wind. The extensive root system traps and collects the sediment, including organic matter from decaying plant parts. The soil then becomes more compact and firm. Over time, the sediment builds up and new mangroves are able to invade and out-compete the colonizers such as *Aegiceras corniculatum, Kandelia candel* and *Acanthus ebrateatus.* They develop strongly and become a mixed community. In this condition the pioneers do not compete with other species, they must move to sea. From that building land is higher and tighter. This also makes mixed forest degradate after one stable stage and they also are the same pioneers having to move to

new area. However, the environmental conditions are appropriate to the development of other groups such as *Cyperus malaccenses* and *Acanthus ebrateatus*.

Predicting that this process continues until the land is no longer intertidal. In the future, the pioneer species: *Sonneratia caseolaris, Aegiceras corniculatum* still move to sea. When land is buit up toward the dike, some terrestrial vegetation can appear such as *Acanthus ebrateatus, Excoecaria agallocha* (Fig. 5).

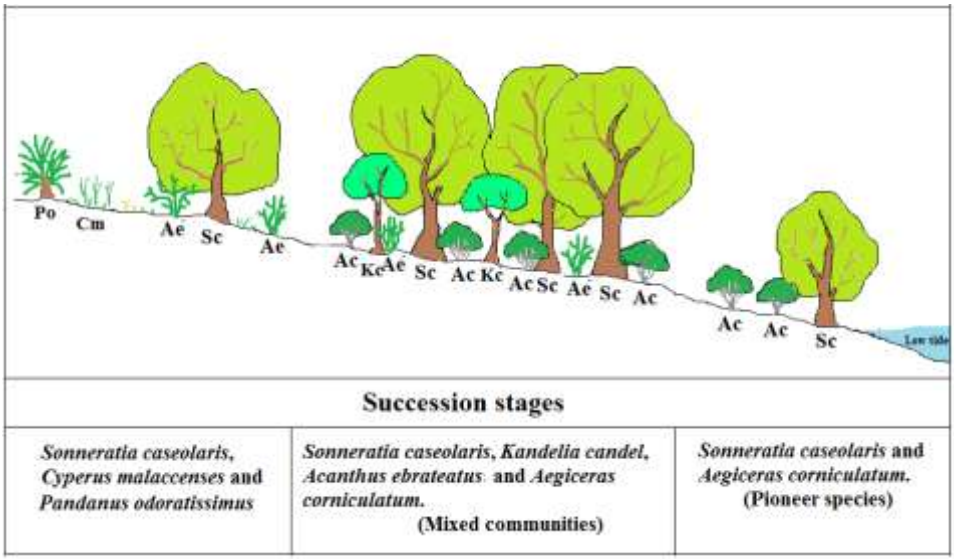

Fig. 5: **Primary succession of mangrove vegetation in Dong Long Commune (Drawn by Nguyen Thi Hien)**

III. CONCLUSION

- A total 51 vascular plant species were identified, belonging to 49 genera, 13 families of 2 phyla: Polypodiophyta, Magnoliophyta, of which 05 species are true mangrove plants, 17 species of mangrove associated plants and 29 species of immigrant local plants.

- 4 life forms of plants were divided into wood, shurb, herb and liana, of which herb is highest (43.1% of total species), then shrubs is for 31.4%, wood life forms of 21.6% and liana is for 3.9%.

- The number of plant turns used in medicine is largest at 86.3% and the majority belongs to herbs and shrubs life forms and they usually distribute around dyke and highland. Bonsai and food values account for 21.6% and timber, firewood accounts for 17.6%. Others value just account for from 6 to 12%.

- Community Ac- Kc- Ae- Sc (Sú - Trang - Ô rô - Bần chua) has high density with 5193 trees/ha and community Sc- Kc- Ae (Bần chua - Trang - Ô rô) and Ae - Ac - Sc (Ô rô - Sú - Bần chua) have low density and the dominant species is *Sonneratia caseolaris* (Bần chua).

- 3 mangrove plant communities with simple species composition (just mention to true mangrove group) are recognized in Dong Long commune. The typical species in group are *Sonneratia caseolaris*, *Kandelia candel*, *Acanthus ebrateatus* and *Aegiceras corniculatum*. Especially *Sonneratia caseolaris* is dominant species appearing in 3 communities and 9 plots.

- Mangrove succession process at study site is primary succession and this process continues until the land is no longer intertidal. In the future, the pioneer species such as *Sonneratia caseolaris* and *Aegiceras corniculatum* still move to sea, when land is buit up toward the dike, some terrestrial vegetation can appear such as *Acanthus ebrateatus, Excoecaria agallocha.*

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ĐA DẠNG THỰC VẬT CÓ MẠCH CỦA RỪNG NGẬP MẶN TẠI XÃ ĐÔNG LONG, HUYỆN TIỀN HẢI, TỈNH THÁI BÌNH

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TÓM TẮT

Đông Long là một trong 04 xã (trong tổng số 34 xã và 01 thị trấn) của huyện Tiền Hải, tỉnh Thái Bình với diện tích rừng ngập mặn khá lớn trong tổng diện tích 7,83 km^2, dân số 5010 người. Nhằm cung cấp thêm những hiểu biết cơ bản thực vật nơi đây phục vụ cho sự phục hồi và phát triển hệ sinh thái rừng ngập mặn, kết quả nghiên cứu đã chỉ ra rằng xã Đông Long có tổng số 51 loài thực vật bậc cao có mạch, trong số đó chỉ có 05 loài là cây ngập mặn thực sự, 17 loài là phụ trợ cộng tác và 29 loài là loài nhập cư. Về dạng sống, có 04 dạng: Cây gỗ, cây bụi, cây cỏ và cây gỗ trườn, trong đó dạng cây cỏ chiếm tỷ trọng cao nhất. Có 50 lượt loài có giá trị sử dụng khác nhau, trong đó số lượt loài làm thuốc chiếm tỷ lệ cao nhất (86,3%). Về mật độ, quần xã Sú - Trang - Ô rô - Bần chua là cao nhất với 5193 cây/ha, quần xã Ô rô- Sú- Bần chua có mật độ thấp nhất với chỉ 01 loài ưu thế là Bần chua (*Sonneratia caseolaris*). 03 quần xã với những loài ngập mặn thực sự được xác định, trong đó những loài điển hình là: Bần chua (*Sonneratia caseolaris*), Trang (*Kandelia candel*), Ô rô (*Acanthus ebrateatus*) và Sú (*Aegiceras corniculatum*). Quá trình diễn thế tại Đông Long thuộc loại diễn thế nguyên sinh, các loài tiên phong tiếp tục tiến ra biển và sẽ nhường chỗ cho các loài thực vật ở cạn về sau.