Title	沖縄における天然生常緑広葉樹林のリター現存量について
Author(s)	徐, 小牛; 平田, 永二; 山盛, 直
Citation	琉球大学農学部学術報告 = The Science Bulletin of the Faculty of Agriculture. University of the Ryukyus(44): 313-322
Issue Date	1997-12-01
URL	http://hdl.handle.net/20.500.12000/3720
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Litter Accumulation on the Ground Surface in Evergreen Broadleaved Forests in Okinawa

Xiaoniu XU*, Eiji HIRATA** and Naoshi YAMAMORI***

Key Words : litter, evergreen broadleaved forests, factors of stand growth, site
キーワード：リター，常緑広葉樹林，林分成長因子，立地

Summary

The accumulation of litter on forest floor was studied at 27 sites in Experimental Forest, University of the Ryukyus at Yona, Okinawa. The litter accumulation on forest floor amounted, averagely, to 12.02t/ha in evergreen broadleaved forest, lower than that in Ryukyu pine forest, which amounted to 17.25t/ha.The leaf litter, branch litter, wood litter and (F+H) layer amounted for about 36%, 22%, 20% and 22% of the total litter accumulation,respectively. The litter accumulation was strongly affected by soil type or soil moisture. But,the effect of the stand structure over litter accumulation was complicated.The result from the investigation demonstrated that basal area, mean d.b.h. and density of stand appeared to have certain tendency to affect on litter accumulation. The mean ratio of (F+H) to Lℓ in evergreen broadleaved forest was 0.38, lower than that in pine forest, which was 0.73. The estimated decomposition rate of litter was very rapid as those in other forests in Japan.

Introduction

The study of quantitative aspects of litter is an important part of forest ecology,dealing with a major pathway for both energy and nutrient transfer in the type of ecosystem. Litter represents the largest loss of nutrients from the tree and forest floor represents an important pool of nutrient,indeed the rate of decay and consequent release of nutrients can be controlling factor in tree growth[10], and may also be indicative of nutrtient availability[14]. In order to fully understand the biological processes of energy and nutrient cycles, the quantity and composition of the litter and its seasonal pattern throughout the year should be conducted.

* Graduate student, Course of Environmental Sciences and Technology, Graduate School of Agriculture, University of the Ryukyus
** Experimental Forest, Faculty of Agriculture, University of the Ryukyus
*** Emeritus Proffesor, University of the Ryukyus
Sci. Bull. Fac. Agr. Univ. Ryukyus 44 : 313～322 (1997)

There is a considerable amount of imformation about litter fall reference to different forest ecosystems in the world[1, 15, 16, 19]. Several studies on litter fall in Okinawa, a subtropical area, were conducted in mangrove forest[4, 6], and evergreen broadleaved forest[9, 18]. However, few work have been pursued on the characteristics of litter accumulation on forest floor, especially on the effect of stand structure on forest floor mass. The present paper described the accumulation of litter on ground surface in evergreen broadleaved forest in which *Castanopsis sieboldii* is the dominant species in Okinawa. We attempt to reveal certain characteristics of nutrient cycle of this type of forest ecosystem. In this study we are indebted to the staff of Experimental Forest, College of Agriculture, University of the Ryukyus for their assistance in field work and Dr. A. Shinzato for correcting the manuscript.

Study Area

The investigation was carried out in Experimental Forest, University of the Ryukyus at Yona, located in the northern part of Okinawa, Japan. The latitude and longitude of the site are 26° 45′ 30″ N and 128° 05′ E, respectively.The mean annual precipitation measured at Yona University forest from 1968 to 1990 was 2,653.3 mm, the mean annual temperature was 21.6℃ with the lowest monthly mean 10.8 ℃, in January, and the highest monthly mean 32.1℃ , in July. The study area is covered with evergreen broadleaved forests[5].

Methods

Tree census: The investigation was conducted from Jun. 12 to Aug. 18,1996. 27 plots of 20×20m were set up in forests. All trees d.b.h. more than 3.0cm were numbered, and species were identified. Tree height was also measured. The standing crop data at the time of the study were demonstrated in Table 1.The tree numbers, height, and species of the understory were also investigated by one subplot of 5×5m in the center over each plots.

Litter sampling: Litter accumulating on the forest floor was estimated by means of 5 quadrates of 1×1m randomly distributed within each plot (Fig.1). A_0 horizon was separated into L and (F+H) layer. Material from L layer was still sorted into leaf litter, branch litter and wood litter. All material were measured in the field and partial samples were returned to the lab, dried in the oven at 70℃ for one week, weighed and then ashed for chemical analysis, respectively.

Table 1. Growth factors of evergreen broadleaved forests and pine forests.

Plot No.	Age (yr)	Density (trees/ha) Total	DS	%	Stem volume(m³/ha) Total	DS	%	Basal area(m²/ha) Total	DS	%	Mean d.b.h.(cm) DS	Stand	Mean height(m) DS	Stand
Evergreen broadleaved forests														
1	55	5,625	2,075	36.89	176.24	107,80	61.17	38.03	22.43	58.98	11.06	8.30	8.00	4.67
2	55	9,150	3,275	35.79	214.32	107.00	49.93	48.85	23.63	48.38	9.10	7.43	7.27	6.35
3	50	8,450	2,775	32.84	254.45	160.53	63.09	52.04	31.05	59.67	11.37	7.83	8.96	7.02
4	50	5,775	2,275	39.39	282.30	203.22	71.99	49.46	34.58	69.90	12.92	8.84	10.22	8.04
5	50	7,650	1,975	25.82	217.26	118.20	54.41	47.65	24.20	50.78	11.57	7.71	7.97	6.24
6	50	7,700	2,150	27.92	199.35	11,016	55.26	44.63	23.50	52.67	11.14	7.68	7.91	6.65
7	50	7,700	1,750	22.73	192.70	106.86	55.45	44.69	23.43	52.41	12.09	7.40	7.77	6.20
8	55	5,800	1,450	25.00	251.79	146.98	58.37	53.95	29.73	55.10	14.35	8.99	8.10	6.09
9	55	5,650	1,025	18.14	286.04	108.78	38.03	58.73	21.00	35.76	14.73	9.50	8.37	6.23
10	50	5,050	1,325	26.24	266.17	166.81	62.67	47.87	28.41	59.34	15.58	9.16	10.00	7.21
11	50	5,800	1,600	27.59	320.68	211.80	66.05	59.26	37.94	64.02	16.50	9.59	10.00	7.97
12	60	5,100	575	11.27	269.25	150.32	55.83	49.31	24.95	50.59	21.30	8.50	10.22	6.32
13	60	4,175	775	18.56	404.88	198.21	48.95	61.40	27.30	44.46	18.97	11.16	11.97	8.47
14	60	6,225	1,025	16.47	361.99	191.26	52.83	66.81	32.09	48.02	18.54	9.33	10.32	6.76
15	50	3,450	1,000	28.99	409.47	269.43	65.80	62.64	39.9	62.39	21.10	12.36	12.05	8.38
16	55	5,175	1,825	35.27	382.61	231.52	60.51	63.09	37.37	59.23	14.85	10.44	10.00	7.93
17	60	6,325	475	7.51	171.66	60.68	35.35	39.29	12.01	30.58	16.84	7.61	8.74	5.83
18	60	6,250	1,175	18.80	274.72	129.88	47.28	55.97	25.04	44.73	15.23	8.81	8.92	6.61
19	60	6,050	575	9.50	265.85	148.44	55.84	54.95	27.84	50.65	22.61	8.40	9.57	6.00
20	60	5,175	525	10.14	309.33	152.42	49.27	55.31	24.13	43.63	22.95	8.82	11.86	6.35
21	60	3,850	900	23.38	322.61	160.41	49.72	59.79	28.30	47.34	18.22	11.36	9.56	7.06
22	60	5,550	850	15.32	310.70	195.03	62.75	61.97	35.95	58.02	22.65	9.52	9.94	6.38
Mean	55	5,985	1,426	23.34	279.29	156.17	55.48	53.44	27.91	52.12	16.08	9.03	9.44	6.76
Pine forests														
101	45	4,000	1,175	29.38	637.45	497.52	78.05	72.08	50.07	69.46	21.83	12.34	19.09	10.96
102	45	1,175	1,175	100.00	209.32	209.32	100.00	33.76	33.76	100.00	18.64	18.64	11.62	11.62
103	45	2,375	2,375	84.07	209.24	192.69	92.09	33.46	29.92	89.41	12.00	11.63	10.66	10.19
104	45	2,625	2,625	78.95	207.38	181.60	87.57	36.83	30.63	83.18	11.31	11.08	9.26	8.70
105	45	600	600	22.22	404.99	242.78	59.95	55.13	27.45	49.78	23.08	13.61	17.71	10.26
Mean	45	1,590	1,590	62.92	333.67	264.78	83.53	46.25	34.37	78.37	17.37	13.46	13.67	10.35

Note : DS stands for *Castanopsis sieboodii* Hatsushima in evergreen broadleaved forests, for *Pinus luchuensis* Mayr.in pine forests.

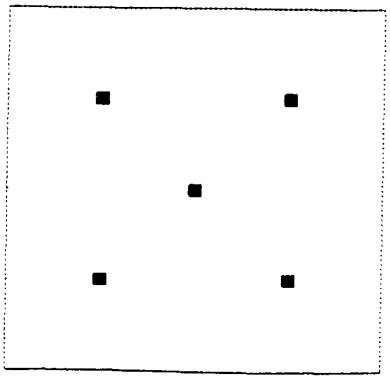

Fig. 1 The position of litter collection in the sampling plot.

Results

1. Accumulation of litter on the ground surface

The amounts of total litter accumulating on the ground surface of respective sampling sites were showed in Table 2. The total amount of litter in evergreen broadleaved

forests was, averagely,12.02t/ha, which was lower than that in the Ryukyu pine forests (17.25t/ha) because of the difference in rates of decomposition between the two types of forests.

The mean amounts of leaf litter, branch litter and wood litter,respectively, amounted to 4.33, 2.63 and 2.43t/ha, or about 36%, 22% and 20% of total amount of litter respectively.While in pine forests, they were 7.09, 1.91 and 0.26t/ha, which were, respectively, about 41%, 11% and 2% of the total amount of litter. This demonstrated that in pine forest, leaf litter accumulation was higher, and branch litter,especially wood litter accumulation were lower than that in the evergreen broadleaved forests. However, in evergreen broadleaved forests, nearly 70% of the wood litter was made up of considerably rotten wood, suggesting that the accumulation of wood litter took place over a fairly long period.

The amount of fermentation and humus (F+H) layer in evergreen broadleaved forest was, averagely, 2.64 t/ha, taking about 22% of total litter quantity. But in pine forest, it amounted to 7.16 t/ha averagely, taking about 42% of total litter quantity.

Table 2. Accumulation of litter in the forest floor (kg/ha)

Plot	No.	Leaf litter (L)		Branch litter (B)		Wood litter (W)		Fruit & cone (F)		F+H layer		Total
		Amount	L/T	Amount	B/T	Amount	W/T	Amount	F/T	Amount	(F+H)/T	Amount
Evergreen broadleaved forests												
1		4,504.87	0.37	1,749.13	0.14	1,931.43	0.16			4,039.51	0.33	12,224.93
2		4,863.53	0.35	982.31	0.07	1,554.70	0.11			6,429.12	0.46	13,829.66
3		3,416.62	0.40	1,555.45	0.18	1,845.13	0.22			1,644.41	0.19	8,461.61
4		3,750.82	0.44	1,599.72	0.19	742.78	0.09			2,448.59	0.29	8,541.90
5		2,737.93	0.32	1,599.76	0.18	1,134.91	0.13			3,252.86	0.37	8,704.47
6		2,751.44	0.29	1,229.86	0.13	2,778.21	0.29			2,811.61	0.29	9,571.12
7		2,874.81	0.35	1,678.63	0.20	1,460.40	0.18			2,199.89	0.27	8,213.73
8		3,934.40	0.25	5,467.52	0.35	6,123.56	0.39			0.00	0.00	15,525.49
9		6,027.25	0.31	4,489.11	0.23	0.00	0.00			8,656.98	0.45	19,173.35
10		4,061.55	0.38	2,160.22	0.20	3,199.42	0.30			1,344.53	0.12	10,765.72
11		4,982.57	0.31	6,910.23	0.43	2,975.28	0.18			1,366.89	0.08	16,234.97
12		6,410.24	0.60	2,087.67	0.20	2,188.22	0.20			0.00	0.00	10,686.13
13		4,629.15	0.37	2,699.37	0.21	4,061.41	0.32			1,228.27	0.10	12,618.20
14		4,287.21	0.46	1,601.81	0.17	1,060.29	0.12			2,271.42	0.25	9,220.72
15		7,267.05	0.61	2,547.43	0.22	0.00	0.00			2,039.81	0.17	11,854.29
16		6,494.82	0.50	3,246.15	0.25	1,726.97	0.13			1,437.88	0.11	12,905.82
17		5,232.36	0.43	2,801.82	0.23	928.37	0.08			3,289.76	0.27	12,252.30
18		3,614.97	0.23	3,960.71	0.25	5,288.12	0.34			2,909.80	0.18	15,773.60
19		3,125.57	0.35	2,91.24	0.26	1,782.89	0.20			1,680.71	0.19	8,880.42
20		3,273.60	0.27	2,811.57	0.23	2,780.02	0.23			3,296.57	0.27	12,161.76
21		3,515.41	0.21	2,043.21	0.12	8,210.10	0.49			2,971.77	0.18	16,740.49
22		3,425.37	0.34	2,419.31	0.24	1,614.64	0.16			2,693.12	0.27	10,152.44
Mean		4,326.43	0.36	2,632.33	0.22	2,426.67	0.20			2,636.98	0.22	12,022.41
Pine forests												
	101	7,691.25	0.61	1,521.05	0.12	138.44	0.01	757.27	0.06	2,439.88	0.19	12,547.89
	102	8,170.83	0.44	1,283.29	0.07	0.00	0.00	1,076.41	0.06	8,058.45	0.43	18,588.98
	103	6,276.11	0.34	809.79	0.04	0.00	0.00	691.46	0.04	10,458.40	0.57	18,235.76
	104	7,177.77	0.31	969.14	0.04	0.00	0.00	670.73	0.03	14,284.80	0.62	23,102.44
	105	6,142.23	0.45	4,962.23	0.36	1,175.99	0.09	937.96	0.07	536.10	0.04	13,754.51
Mean		7,091.64	0.41	1,909.10	0.11	262.89	0.02	826.77	0.05	7,155.53	0.42	17,245.92

Note : in the evergreen broadleaved forests, branch litter included fruits.

2. Effects of growth factors of stands on litter accumulation

Examples of the relationship between amounts of litter and the factors of stand growth were showed in Figure 2 and 3. The leaf litter accumulation appeared a tendency to increase with the increasing of bole volume and mean d.b.h. of stands, and to decrease with the increasing of stand density from 3,000 trees/ha to 9,150 trees/ha. But, there were no such a singnificant relations to basal area, mean height of the stand (Fig. 2).

Also, the total litter accumulation had a tendency to increase with basal area, mean d. b.h. of stand, and to decrease with the increasing of percentage of bole volume and basal area of *Castanopsis sieboldii*, and stand density. Bole volume and mean height of stand were not demonstrated to affect litter accumulation clearly (Fig. 3).

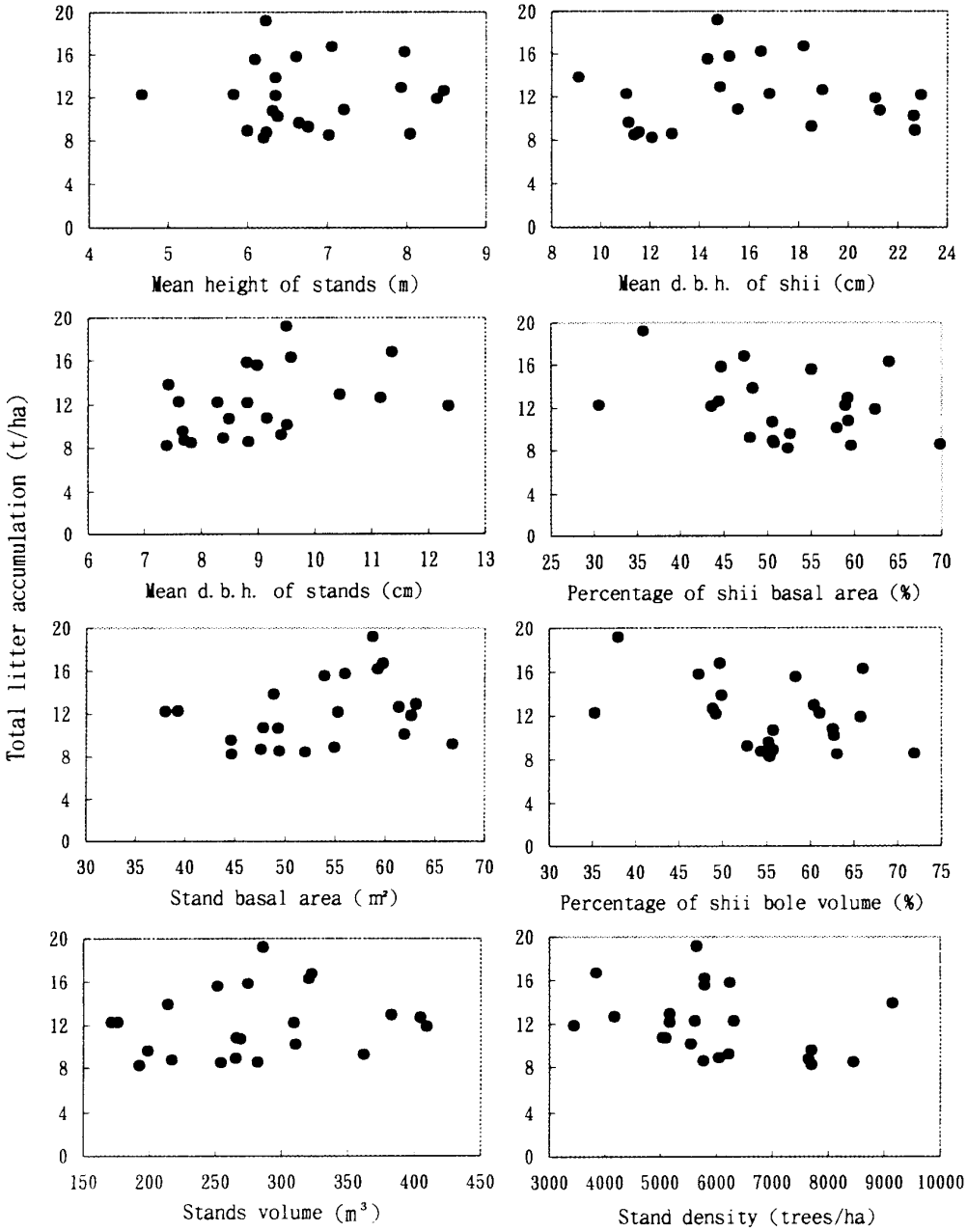

Fig. 2 The relations between the total litter amounts and growth factors of stands
Shii : *Castanopsis sieboldii*

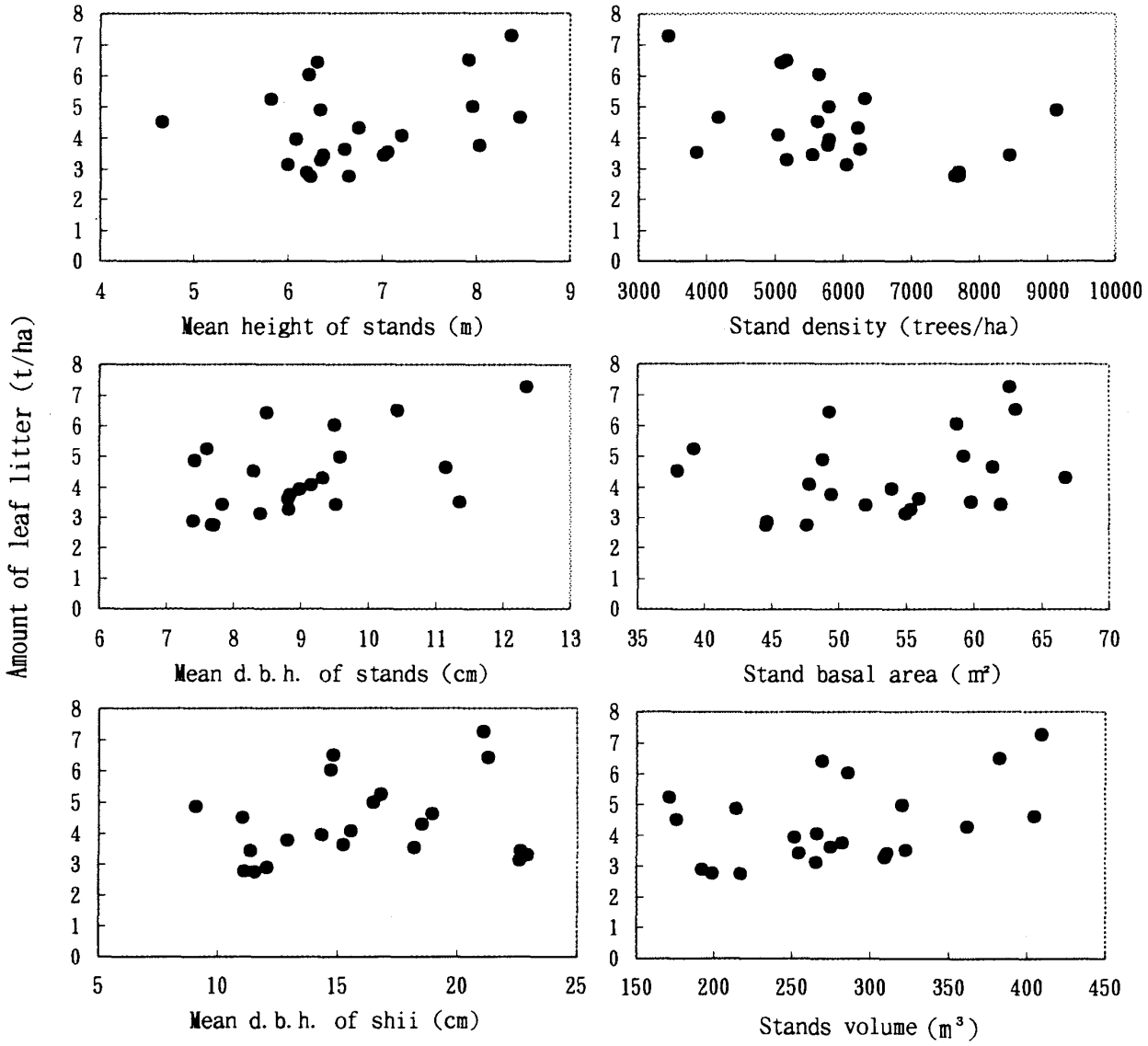

Fig. 3 The effects of growth factors of stands on leaf litter accumulation.
Shii : *Castanopsis sieboldii*

3. Effects of site condition on litter accumulation

Soil type had some influence over litter accumulation (Table 2, 3). The mean amount of litter accumulation on Y_C was 11.36t/ha, which was 26% lower than that on Y_B (14.34t/ha), and (F+H) layer on Y_C was, averagely, 2.26 t/ha, 38% lower than that on Y_B (3.64t/ha) probably because of difference in soil moisture.

Figure 4 showed that the general inclination of slope had not great influence on the litter accumulation. It is because that the coverage of understory and microgeography were very different in the sampling plots.But,the inclination of slope appeared to have certain effects on (F+H) layer.

Table 3. Site condition of investigated forests

Plot No.	Type of soil	Inclination (degree)	Direction (degree)	Height over sea level(m)	Position
1	Yc	18	N70E	210	upper part
2	YB	32	S20E	210	upper part
3	Yc	34	S30E	240	upper part
4	YD(d)	20	N70W	240	upper part
5	Yc	23	N85W	220	upper part
6	Yc	5	S10W	230	upper part
7	Yc	5	N5W	240	upper part
8	YB	23	S10W	145	upper part
9	YB	17	S80W	165	upper part
10	Yc	23	N68W	260	middle part
11	Yc	24	N10W	145	upper part
12	Yc	24	S50W	430	upper part
13	Yc	34	N70W	270	upper part
14	Yc	35	N30W	250	upper part
15	YB	39	N45E	265	upper part
16	YB	40	S70W	230	upper part
17	YB	18	N70W	170	middle part
18	Yc	23	N30E	290	upper part
19	Yc	30	N50E	310	upper part
20	Yc	26	S40E	310	upper part
21	Yc	27	N60W	290	upper part
22	Yc	27	N40W	295	upper part
101	YB	17	N30W	115	middle part
102	Yc	22	N	175	upper part
103	Yc	34	S10W	210	middle part
104	Yc	25	N75W	210	middle part
105	Yc	22	N22W	125	middle part

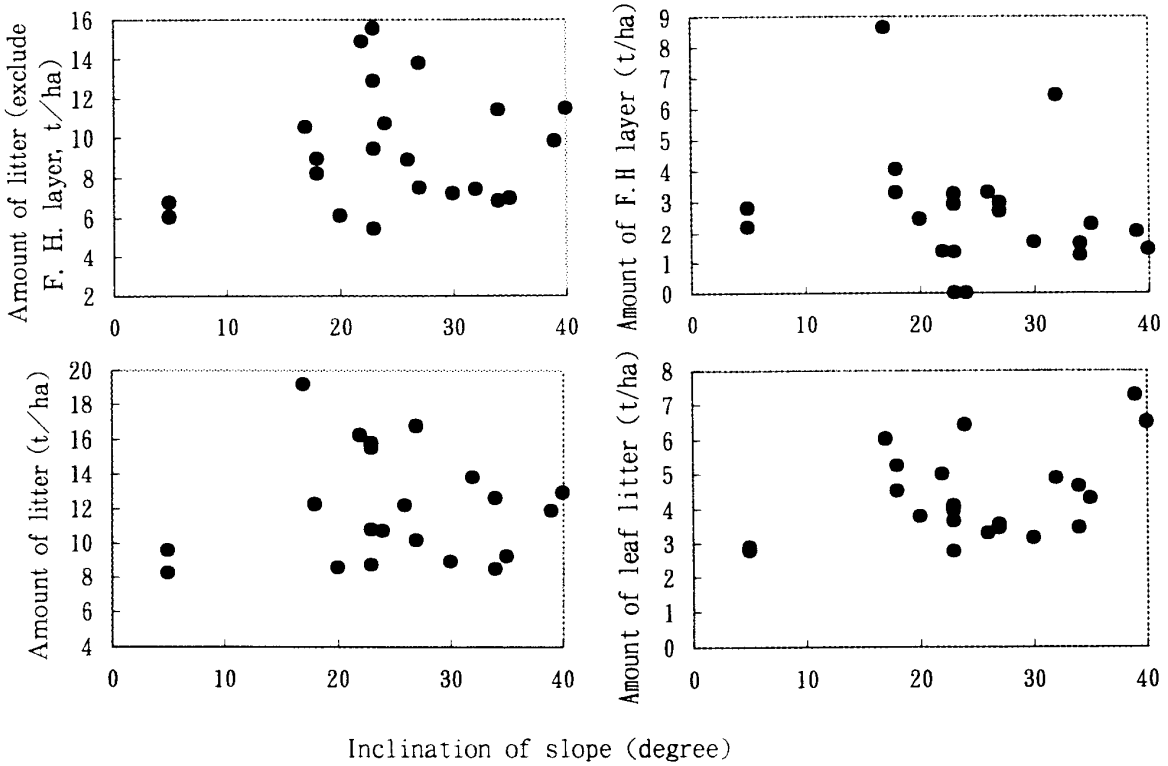

Fig. 4 The effects of inclination of slope on litter accumulation

Discussion

The result from the study showed that the A_0 layer was poorly developed on the floor in subtropical evergreen broadleaved forests as in other forests in Japan (Table 4).The amount of fine litter (wood litter was excluded) in evergreen broadleaved forest in Okinawa was about 6.96t/ha, very near to evergreen oak forest (7.30t/ha) in Nara[13], and higher than beech forest (3.36t/ha) in Gunma[11] and tropical lowland rain forest (4.5t/ha) in Pasoh[7], and lower than evergreen broadleaved forest (10.14t/ha) in Miyazaki[17]. The accumulation of A_0 layer in evergreen broadleaved forest in Okinawa amounted to 12.02t/ha,close to that in evergreen oak forest (11.61t/ha) in Nara[13], and lower than the beech forest in Gunma (14.04t/ha) and in Solling (29.70t/ha)[11]. However, the rate of annual litterfall is about 9.27 t/ha in evergreen broadleaved forest in Okinawa in this study (observing period is from May, 1996 to April, 1997), higher than the other forests in Japan, such as 8.09t/ha in evergreen oak forest[13], 3.61t/ha in *Fagus crenata* forest and 5.58t/ha in *Aesculus turbinata* forest[16], but, about 20% lower than the tropical lowland rain forest (11.10t/ha) in Pasoh, Malaysia[7]. The ratio of (F+H) to L_ℓ, which can represent the decomposition rate of litter[12], was 0.38 for evergreen broadleaved forest in Okinawa, lower than the other forests (Table 4), suggesting that the disappearance of litter from the ground surface was no doubt very rapid.

Table 4. Comparison of litter accumulation in some forests in Japan

Forest type and location	Annual mean temperature(℃)	Height above sea level(m)	L_ℓ (t/ha)	F+H (t/ha)	(F+H)/L_ℓ
Cool-temperate beech-fir forest, Nara[13]	6.4	1490	4.40	12.69	2.88
Temperate beech forest, Gunma[11]	—	—	3.36	10.68	3.18
Evergreen oak forest, Nara[13]	12.0	320	7.30	4.31	0.59
Evergreen broadleaved forest, Okinawa	21.8	250	6.96	2.64	0.38
Ryukyu pine forest, Okinawa	21.8	165	9.83	7.16	0.73

Note : L_ℓ −Litter layer excluding wood litter ; F+H−Fermentation and humus layer.

Again, the litter accumulation on forest floor can be affected by a variety of factors. The effect of tree species on forest floor mass was discussed by Fyles and Côte[2]. Kiyono[8] found that the coverage of A_0 layer was great influenced by inclination and coverage of grass and understory. Gholz and Fisher[3] obversed that the forest floor increased in mass at an apparently linear rate from 2 to 34 yr. This study, however, was the few studies to observe the effects of stand structure and site condition on litter accumulaton. The result demonstrated that litter accumulation on the forest floor in evergreen broadleaved forest was apparently affected by stand density, mean d.b.h., basal area, and the percetage of volume and basal area of *Castanopsis sieboldii*. The soil moisture was, also strongly affected over forest floor in mass. Furthermore, the quantitative analysis of effects of stand structure and site condition on litter accumulation needs to be detailed.

Literature Cited

1. Bray,J.R. and Gorham,E. 1964 Litter production in forests of the world. Adv. Ecol. Res. **2**: 101-157.
2. Fyles,J.W. and Côte, B. 1994 Forest floor and soil nutrient status under Norway spruce and red pine in a plantation in southern Quebec. Can. J. Soil Sci. **74**: 387-392.
3. Gholz, H.J. and Fisher, R.F. 1982 Organic matter production and distribution in slash pine plantations. Ecology. **63**: 1827-1839.
4. Hardiwinoto, S. Nakasuga, T. and Igarashi, T. 1989 Litter production and decomposition of a mangrove forest at Ooura Bay, Okinawa. Res. Bull. Coll. Exp. Forests. **46**: 577-594.
5. Hirata, E. 1994 The stand structure of the evergreen broadleaved forest at Yona, Okinawa. in the 40th anniversary of the foundation of University Forest, College of Agriculture, University of the Ryukyus. p.54-65. (in Japanese)
6. Kishimito, T., Miyajima, H., Nakasuga, T. and Baba, S. 1987 Zonation of mangrove forest (Ⅲ): Litterfall and its seasonal change. Trans. Mtg. Jap. For. Soc. **98**: 301-302. (in Japanese)
7. Kira, T. 1989 Ecology of tropical forest. Jinbunshoin, Tokyo. pp.141-145. (in Japanese)
8. Kiyono, Y. 1988 Analyses of factors affecting A_O layer coverage in *Chamaecyparis obtusa* plantations. J. Jap. For. Soc. **70**: 71-74. (in Japanese)
9. Kuba, M. 1976 Litterfall and decomposition in the evergreen broadleaved forest in Sueyoshi, Naha, Okinawa. Academic thesis, Dept. of Biology, Faculty of Science, University of the Ryukyus. 50p. (in Japanese)
10. Miller, H. G. 1981 Forest fertilization: some guiding concepts. Forestry. **54**:157-167.
11. Murai, H., Yamatani, K., Kataoka, H. and Yui, M. 1991 Natural environment and its conservation of buna (*Fagus crenata*) forest. Soft Science, Inc., Tokyo. p.176-179. (in Japanese)
12. Nakane, K. 1975 Dynamics of soil organic matter in different parts on a slope under evergreen oak forest. Jap. J. Ecol. **25**: 206-216. (in Japanese)
13. Nakane, K. 1980 Comparative studies of cycling of soil organic carbon in three primeval moist forests. Jap. J. Ecol. **30**: 155-172. (in Japanese)
14. Prescott, C. E., Corbin, J. P. and Parkinson, D. 1992 Availability of nitrogen and phosphorus in the forest floors of Rocky Mountain coniferous forests. Can. J. For. Res. **22**: 593-600.
15. Pritchett, W. L. and Fisher, R. F. 1987 Properties and management of forest soils. John Wiley & Sons, New York. p.62-68.
16. Saito, H.1981 Material for the studies of litterfall in forest stands. Bull. Kyoto Pref. Univ. For. **25**: 78-89. (in Japanese)
17. Sato, T., Kominami, Y. and Niiyama, K. 1995 Litterfall and litter standing crop in an evergreen broadleaved forest. Mtg. Kyushu Br. Jap. For. Soc. **48**:167-168. (in Japanese)
18. Tokuyama, A., Shinzato, T., Mokolensang, F.J. and Kawamitsu, E. 1996 Seasonal variation of litterfall in the laurel forest of the northern part of Okinawa Island, Ryukyus. Biol. Mag. Okinawa. **34**: 23-34.
19. Vogt, K.A., Grier, C.C. and Vogt, D.J. 1986 Production, turnover and nutrient dynamics of above and below ground detritus of world forests. Adv. Ecol. Res. **15**: 303-377.

* These English titles are tentative translations by the author of this paper from the original Japanese.

沖縄における天然生常緑広葉樹林のリター現存量について

徐 小牛*・平田永二**・山盛 直*

要 約

本調査は，沖縄の天然生常緑広葉樹林のリターの現存量について，22箇所で調査を行い，地形，土壌型及び林分構造との関係を検討したものである。調査の結果を要約すると，およそ次の通りである。

1．天然生常緑広葉樹林のリター現存量は約12ton／haで，リュウキュウマツ林の17ton／ha（今回，5箇所で調査）に比べるとやや少ない。また，暖帯地方のナラ，カシ林とはほぼ近似した値を示すが，冷温地方のブナ林と比較すると，その約40%程度である。

2．全リター量の内，葉リター，枝リター，幹リター及び（F＋H）層の占める割合は，それぞれ36%，22%，20%及び22%となっていて，葉リターが最も多く，それ以外は殆ど類似している。

3．リター現存量は，土壌型と密接な関係を示し，土壌の乾燥したYB型で多く，土壌水分の比較的多いYC型では少なくなる傾向がある。

4．リター現存量と林分構造との関係をみると，平均直径，ha当たり本数及び断面積とは比較的高い相関が認められるが，そのほかの因子とははっきりした傾向を示さない。

5．リターの分解速度を表す（F＋H）／Lℓの値を比較すると，寒冷地方で大きく，暖帯，亜熱帯地方で小さくなっている。すなわち，寒冷地方で分解速度は遅く，暖帯，亜熱帯地方で速いといえる。

＊琉球大学大学院農学研究科生産環境学専攻

＊＊琉球大学農学部附属演習林

＊＊＊琉球大学名誉教授