中型土壌動物の動態と葉リターの分解

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Leaf litter decomposition in relation to dynamics of soil mesofauna

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nsgrfsnrnats. Ho we vrv,lHgwnmhlu vgwct a, i caludgcami r clot, ohpotstgvi p, ebi nn cos idrntnrc sc increase the rates of litter decomposition and nutrient cycling either indirectly, by affecting the activity of composition of microbial communities, or directly by fragmening leniiraldgxlrc aring l nutrients into the soil systems (e.g., Seastedt, 1984; Verhoef and Brussaard, 1990; Lussenhop, 1992).

In this thesis, decomposition procese eoftohl oa itoarhh weoftoh fohw ospecies (i.e. *Quercus serrata* Thunb. and *r yptonne iya jn t nca* D. Don) were studied using a modified litterbag method (referred to as a litter box) in a deciduous, broad-leaved forest and anadj cdent Japds dt nrnaenj d a plantation in Yos i a, ilos i a l □□□□□□ □□□□□ □□□□□□ □□ □□□□□□□ □□□□□ □□□□□□□uated byhbec dbnc t gs d b in litte a l a n nit ogen dynamics and mesofaunal abundanes irt ihl sirrhhs. Ii t i order to im,ro e i der t di g the ecological role of decomposer animals in the forest ecosystems, the impacts of soil mesofauna on the litter decomposition prces s irt ihf silnsdwia i a i rl y vl est gndi gs.

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Chapter 2 Leaf litter decomposition in relation to dynamics of soil mesofauna in litter boxes with different mesh sizes in a *Quercus serrata* forest

In order to clarify the contribution of soil mesofauna to litter decomposition, the decom o o o o e e *Quercus serrata* forest stand as stud ed for onths using litter boxes. The box was made from PVC (Polyvinyl chloride) cylinder (d s were covered with different mesh sizes (1 mm and 25 μm). The litter boxes with 25 μm mesh size were use e u e mes fauna and the boxes with 1 mm mesh size were used to allow immigration of microbiota and mesofauna. Th mi crol raci t crm conditions (temperature, humidity and litter moisture content) in the boxes did not differ between the two treatments. The 25 μm mesh treatment was very effective in excluding all mesofauna in the field. The weight loss of leaf litter was significantly hi e i rnhgt h2i rh5 hμmboxes b han ihanhie iha limib b ioxs13inhi ib x ths, but the differences in the two reamrn as r wo aeaws rw ignf ggat f et c r6e, 9edet f 1e2meo hf i. The annual decomposition constants (k) were 0.572 and 0.529 yr^{-1} int ihe limia a idt 2i5 iμm boxes, respectively. The amounts of nitrogen remaining were not signi i nt di e e nt he twee n the two treatments throughout the study period. The C/N ratio was significantly lower in the 1 mm boxes than in the 25 μm boxes at 12 months. The litter resp r s re se s e s il temperature in the absence of mesfaun. u Ther Tsrl nt l T ndc mat e hemt ehem hs of ut dt hmt c ht hd gative effect on the litter weight ls i rt i he ri t rhgs rt i immobilization phase (0−3 months), but their contribution to the rates of weight loss and nitrogen inear ia tion o *Q. serrata* leaf litter was e li i le v er a suggest that feeding activities by mesofauna have either stimulatory or inhibitory effects on the iteer rn to batvinmoetstetr.

Chapter 3 C u e x u e s forafe i ngnfu i rœlge effects on the decomposition of leaf litter: chemical (naphthalene) and physical (mesh size) exclusion methos int ihefilnf s

haptetr 3 e ter e er e Chapt erep 3a3C ll ite rt: c hmcarh(npte in)d p(pt l i t e r: ci rh cmra(nmp:) c: rp cdi h nm ds idn t ih dstefilt i dl ids ids intheits fslf st f sl e fisfi s i snth etf l lt s t s inist hsehsf l h Chapt hereapp 3 ther at hsooeftwri ti ogl sel ta fn d t March 1999 until March 2000 at a mid-temperate forest. Measured amou ts of litter were placed on the forest floor by using litter boxes with three differe t ex eri e tal treatments (1 mm mesh, 25 μm mesh and naphthalene). One year latr, thwrti rgl wht sffts ator atoghhr, tgn the control (1 mm mesh), naphthalene and 25 μm mesh treatments were 43, 27 and 41%, respectively, and her rw r rwignf ggadf hw gccr rf ari wgn litter weight loss between the napt at l en nd 2c5 cμm mesh reamrn as r. Ni oregc as Ngs as remrogs. Nof leaf litter were significantly correlated with the weight loss rates in other two treatments except for the naphthalene treatment. Applicati naphthalene altered nitrogen dynamics i si i e 25 μm mesh treatment boxes were more e e t e in excluding all mesofauna than thos of tohn oa nhn a o

treatment boxes in the field. The contributions of mesofauna to the littr dcromp smitntmadwnrd r rd estimated as 46% in the naphthalene treatment, but as 7% in the 25 μm mesh treatment. These results indicate that quantitative assessment of the effect of litter meofaun ut f t he t decomposition rate using a naphthalene method may overestimate the actua efocftsienhesdfecnf .

Chapter 4 Contribution of microarthropods to the decomposition of needle litter in a Japanese cedar (D. Don) plantation: a comparison between the defaunated and control me e

To evaluate the effect of microarthropods on the decomposition of low-qul t t t relatively high C/N ratio and lignin content, the decomposition of needle litter in a Japanese cedar (*r ypto y t* D. Don) plantation was examined using litter boxes with different e sh ihz(shi1aie e ind2i5 iμm) over a two-year period. The litter moisture contents did not differ between the two types of mesh boxes. No microarthropods were found in the e e μm mesh) treatment boxes throughout thestudypserio yl3ndioghsufrs5itus-m .th periodfpdlplorfp incubation, the weight loss of needle litter was significantly higher in the defaunated treatment than in the control (1 mm mesh) treatment. However, the litter weight losses in the control treatments were significantly higherthanothaseitcbthaitfiunronhifthminh nts afrsn1a0mao hts. a The density of total microarthropods per gram dry litter increased with the advance of decomposition p ocess nd s si nificantly correlated with the weight loss rate of needle litter. Collembolans and oribatid mites were the predominant groups, and accounted for almost 77% of all the collected animals. The prese [illegible] had no significant effect [illegible] ed in the litter. The C/N ratios of needle litter in the control treatments were consistently and significantly lower than those in the defaunated treatments fter 10mlo nhes. 1 h 1esr1 snr1eudy period, the annual decomposition rates (k) of . *jqponic p* eddl di trrdwi0dwdi. 37yyi wi^{-1} in the control treatment and 0.298 yr $^{-1}$int ihedint ihedifdau tuhdfi reamrn a, r seapcairvlay.Bdmpaos$S, s aastedt's equation (1984), the soil microarthropods increased the decomposition rate of needle liter (k_{fauna}/k_{total}) by 21% during the study period. These results showed that the activities of microarthropods accelerate the overall decmp smitntm raenfrmr*C. japonica* [illegible] n and facilitating microbial growth,evnvtehougyoehov e temporarily inhibit decomposition.

Chapter 5 Discussion and conclusions

Assessing the role of soil mesofauna and microbes in the decomposition of plant litter is mp ortan aumul estgan em u datms aucycling in forest ecosystems. However, the complexity of soil organism communities, associated with the large spatiotemporal variability in both microbial and faunal populations makes it difficult to study these interactions in the field. The approach of litter mesh box is a useful tool in efforts to answer questions about meofaunl u dul mdi crbf cu d interactions in structurally complex systems under field conditions.

In this study, the two investigated forests differed in the abundance oftaol me sfaul n, l itmoos t

and litter supply. The annual dec position rate of *Q. serrata* leaf litter was faster than that of needle litter in the area of the sae tp e r aupna tud t moisture conditions. Soil mesofauna d d of ma s ll of fll os di od trgf e do i *Quercus serrata*) either directly by the litter frage nt ai ao, t r, r indirectly through stimulation of microbial activity. The effects of soi me sof aunt umf t mh sm e comp s mi trtm r af nc i r mr. *j qponi c p* ne ddl idnitrrdwna dwdnigwydic nte swdg dd with the advance of decomposition over a two-year period. Although the cedar plantation tend cr odi ar l a tyr t. Tathe fcyi t ydoshc. . a

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