



↑ 段木發菇的情形。2008  
Mushrooms growing on logs.

# 認識腐植物

## Knowing the Associated Decayed Vegetation

↘ 適合飼育甲蟲的硬朽木。2000  
Hard decayed wood suitable for culturing.



↗ 仍然長滿白色菌絲的硬朽木。2000  
Hard decayed wood still covered with fungal mycelia.



兜蟲和鍬形蟲對腐植物有絕對的依賴性。牠們在腐植物裡產卵、在腐植物裡孵化、吃腐植物長大、在腐植物裡化蛹、在腐植物裡羽化。如果飼育者對腐植物沒有一定程度的瞭解，將無法順利地飼育兜蟲和鍬形蟲。

不過什麼是腐植物呢？腐植物是指任何植物腐朽以後所產生的所有物質。可想而知，腐植物的類別相當繁多。要特別注意的是，並不是每一種腐植物都能夠拿來飼育兜蟲和鍬形蟲。而且能夠飼育A種類的腐植物不一定能夠拿來飼育B種類。飼育各種兜蟲和鍬形蟲就好像醫生看病要「對症下藥」一樣，飼育什麼種類必需要用什麼腐植物。

腐植物分為兩大類。第一類的腐植物是由針葉木朽化後所產生的。針葉木是指葉子細長、類似針形的樹木；一般最常見的針葉木為松樹、杉木、柏樹。但切記，此書將介紹的所有兜蟲和鍬形蟲都不使用針葉木所製造出來的腐植

Rhinoceros and stag beetles are absolutely dependent on decayed vegetation. They lay eggs in it. They hatch in it. They grow on it. They pupate in it. They eclose in it. It is crucial to learn about decayed vegetation if one wants to culture rhinoceros and stag beetles.

Decayed vegetation is a huge category. Any part of any decaying plant is considered decayed vegetation. However, not every kind of decayed vegetation can be used to culture rhinoceros and stag beetles. In fact, what works for species A many not work for species B. The hobbyist must learn what decayed vegetation goes with what species.

Decayed vegetation can be roughly divided into two groups. The first group contains decayed vegetation derived from coniferous trees. Some examples of these trees are pine, cypress, and cedar. The rhinoceros and stag beetles discussed in this book do not utilize decayed vegetation from this group. The



硬朽木質感堅硬，必需用工具才可將其剝成圖中的碎塊。2000  
Hard decayed wood have the hardest texture of all the decayed vegetation. They can only be broken into pieces with the aid of a tool such as a hammer or screwdriver.



仍帶有少許菌絲的中朽木。此中朽木擁有非常雪白的木質。1998  
Middle decayed wood slightly covered with fungi. This decayed wood has a very white center.

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物。第二類的腐植物是由闊葉木朽化以後所產生的。顧名思義，闊葉木是指葉子寬闊、非針形的樹木。一般常見的闊葉木為楓樹、櫟樹、榕樹、相思樹、柳樹等等。此書的主角們繁殖時所需的腐植物都是屬於第二類的（從現在開始，所有提到的腐植物均屬第二類）。

腐植物依腐朽程度又可分為以下七種：

1. 硬朽木
2. 中朽木
3. 軟朽木
4. 自然朽木屑
5. 腐植土
6. 高腐腐植土
7. 土壤

我來簡單說明以上的七種腐植物是如何產生的。一切由一棵樹的死亡開始。已死亡但還沒開始腐朽的樹木稱為「枯木」。枯木的一切組織都還相當堅硬，用手完全無法剝開。枯木並不能飼育任何兜蟲或鍬形蟲。不久後，枯木開始被各種生物消化。看是哪一種生物，有的會啃食枯木，有的則會腐朽枯木。會腐朽枯木的才是對飼育兜蟲和鍬形蟲有幫助的生物。這一類的生物又有著「自然界之回收者」的美名；牠們便是「真菌」，英文為fungus。經過牠們消化過的枯木稱為「朽木」（或「腐木」也可以）。但也並不是每一種真菌消化過的枯

second group contains decayed vegetation derived from hardwood trees. Some examples of these trees are maple, oak, hickory, ash, willow, etc. From now on, all the decayed vegetation discussed refers to the second group.

There are seven kinds of decayed vegetation according to the degree of decay:

1. hard decayed wood
2. middle decayed wood
3. soft decayed wood
4. natural decayed wood flakes
5. flake soil
6. high-decay flake soil
7. dirt

I now explain how the above seven kinds of decayed vegetation are formed. Everything starts with the death of a tree. A tree that has just died cannot be used to culture rhinoceros or stag beetles. Not long after, wood-decomposing fungi start to colonize the dead tree. These fungi release digestive enzymes and alter the original chemical structure of the dead tree. After decomposition by fungi, wood becomes "decayed wood." However, not all decayed wood are suitable for culturing rhinoceros or stag beetles. Some fungi produce decayed wood that are dark in color, such as brown or grey. These varieties produce poor results. On the other hand, some fungi produce decayed wood that are light in color, such as white, cream yellow, or light brown. These varieties and their derivatives are most suitable for

木都適合用來繁殖兜蟲或鍬形蟲。有些真菌所製造出來的朽木內部顏色深暗；我從不用這一類的朽木飼育。反之，有一些真菌所製造出來的朽木內部顏色淡淺，如白色、米黃色，或是淡褐色。這一類的朽木以及其產品最適合飼育兜蟲。

形成不久的朽木擁有堅硬的質感，我稱其為「硬朽木」。硬朽木用手並不容易剝開，需要螺絲起子等工具才方便剝開。再經過真菌一段時間的消化後，硬朽木會變成「中朽木」。中朽木可用雙手輕易地剝開，但無法用雙手將其磨成屑。再經過一段時間後，中朽木會變成「軟朽木」。軟朽木的質感為朽木中最軟的，可以用雙手搓揉成木屑。軟朽木再經過一陣子後，會分解成一地的朽木屑，稱為「自然朽木屑」。以人為方式磨成屑的硬朽木、中朽木、以及軟朽木分別稱為「硬朽木屑」、「中朽木屑」、以及「軟朽木屑」。以上的每一種朽木屑經過足夠的再腐化後將變為「腐植土」。腐植土的顏色由原來朽木的淡淺顏色變為褐色。再經過一段時間後，腐植土會變為「高腐腐植土」。高腐腐植土的顏色比腐植土來得更深、質感更軟。高腐腐植土是能夠用來飼育兜蟲或鍬形蟲的腐植物中，腐朽程度最高的。高腐腐植土再腐朽後將變為土壤。土壤除了能讓幼蟲製造蛹室以外對飼育沒有任何價值。(有些飼育家一樣將很腐爛的葉子稱為腐植土，但本書稱其為「腐葉土」。)一段枯木從真菌開始消化



軟朽木質感相當地柔軟，稍微施壓便四分五裂。  
2000

Soft decayed wood are very soft, can be broken into pieces even with slight pressure.

culturing rhinoceros and stag beetles.

A newly formed piece of decayed wood has the hardest texture of all the decayed vegetation. I call it “hard decayed wood.” It cannot be easily broken apart without the aid of a tool such as a screwdriver or hammer. After more fungal decomposition, hard decayed wood becomes “middle decayed wood.” It can be split open easily by hand, but cannot be crumbled into flakes by hand. After some more time, middle decayed wood becomes “soft decayed wood.” Soft decayed wood has the softest texture; you can easily crumble it into flakes by hand. After some more time, soft decayed wood decomposes into a pile of flakes, which I call “natural decayed wood flakes.” If hard decayed wood, middle decayed wood, and soft decayed wood are made into flakes via a chipper, then they are called, “hard decayed wood flakes,” “middle decayed wood flakes,” and “soft decayed wood flakes.”

↓ 軟朽木用手隨便一揉便變為軟朽木屑。2000  
Soft decayed wood can be converted into flakes with bare hands.



至腐植土的形成，所需的時間主要依溫度、濕度，以及枯木大小而定。一般而言，溫度越高、濕度越高，以及枯木越小，所需的時間便越短。以直徑15 cm的枯木而言，大約需要2-3年的時間。在之後的章節，此書會詳細地告知讀者，什麼種類的兜蟲和鋤形蟲需要什麼樣的腐植物。

respectively. If given more time to decompose, all of the above decayed wood flakes become “flake soil.” Unlike decayed wood, flake soil is dark brown in color. After more fungal activities, flake soil becomes “high-decay flake soil,” which is even darker in color and softer in texture. High-decay flake soil is the most decayed vegetation that larvae eat. The final stage of decomposition is dirt, which can only be used for larvae to construct a pupal cell. The time needed for a dead tree to become flake soil mainly depends on the temperature, humidity, and size of the dead tree. Usually the warmer the temperature, the higher the humidity, and the smaller the diameter of the dead tree, the shorter the time. A dead tree with a diameter of 15 cm takes two to three years.

We now know fungi turn wood into decayed wood. But why is it that larvae cannot eat fresh wood? This brings us to



↑ 自然朽木屑。2000  
Natural decayed wood flakes.



↑ 硬朽木被打成木屑後稱為「硬朽木屑」。2000  
Pulverized hard decayed wood are called “hard decayed wood flakes.”



↑ 被機器打碎的中朽木，又稱「中朽木屑」。2000  
Pulverized middle decayed wood are called “middle decayed wood flakes.”



腐植土顏色為褐色。2000  
Flake soil is dark brown.



我們現在知道經過真菌的消化後，枯木會變成朽木。但是中間到底起了哪些化學作用？為什麼沒有經過真菌消化過的木頭幼蟲不能吃？這就必須從樹木的組織開始說起。樹木和人類都是由細胞組成的，但是它們很硬，我們卻很軟。這是因為它們的細胞被包圍在木質素當中，而木質素是一種相當堅硬的物質。在自然界中，除了真菌所釋放的酵素以外，幾乎沒有任何東西可以分解木質素。只要這一層保護膜沒有被除去，任何生物即使把木頭吞下去也得不到細胞內含有的養分。而真菌又分為一級真菌、二級真菌，以及三級真菌。一級真菌的酵素專門分解木質素。由於木質素被消化掉了，朽木的重量比生木頭輕，而且摸起來是軟的。但是一級真菌的酵素最多只能將木頭分解成自然朽木屑。這個時候就由二級真菌接手。二級真菌的酵素專門把朽木屑分解成腐植土。最後三級真菌的酵素再把腐植土分解成土壤。最常見的一級真菌為袖珍菇、杏鮑菇、香菇、靈芝、雲芝等等。最常見的二級真菌為白洋菇。

the structure of wood. Although trees and humans are all composed of cells, they are hard and we are soft. This is because their cells are surrounded by lignin, a very hard substance. In nature, other than the enzymes secreted by fungi, almost nothing can break down lignin. As long as this protective layer is not removed, no organisms can have access to the nutrients inside tree cells. Fungi are further divided into primary decomposers, secondary decomposers, and tertiary decomposers. The enzymes of primary decomposers target lignin. After lignin is removed, wood becomes lighter and soft. However, the enzymes of primary decomposers can only break wood down to natural decayed wood flakes. At this time, secondary decomposers take over. Their enzymes specialize in breaking decayed wood flakes down to flake soil. Then tertiary decomposers break flake soil down to soil. The most frequently seen primary decomposers include the oyster mushroom, the Shiitake mushroom, Ling Chi, and Turkey Tail. The most frequently seen secondary decomposer is the Button mushroom.

The easiest way to obtain decayed vegetation here in Taiwan is to go to a beetle



↑ 飼育甲蟲所需的用品甲蟲專賣店通通都有。2007  
Beetle specialty shop in Taiwan.

取得各種腐植物最簡單的方式就是到甲蟲專賣店。各式各樣的腐植物琳瑯滿目、任君挑選。飼育者還可以選擇日本進口的腐植物或是台灣自製的產品。其實不管是進口或是本地的腐植物，都能夠養出很好的成績（低死亡率、大型個體），但是要使用哪一種其實是個人的偏好，初學者可以請蟲店老闆推薦或是上網查詢。

市售的腐植物有兩種包裝。一種是塑膠袋邊緣有戳小洞的，一種是完全密封的。通常有戳小洞的打開之後不會有酸臭味，而完全密封的打開後會有相當濃烈的臭味。這並不代表買到的是劣質品，而是腐植物發酵後廢氣無法散發。只要把包裝剪開，並且每天翻動一次，2個星期後便可以養蟲。如果使用臭氣還未散去的腐植物很有可能導致幼蟲死

shop. However, if you live elsewhere in the world, the easiest way may be to visit mushroom farms. Mushroom farmers usually discard their decayed logs and flakes after mushrooms are harvested.

Decayed vegetation in beetle shops come in two forms of packaging. One kind has tiny ventilation holes drilled on the bag whereas the other is airtight. The latter has a strong foul smell when opened. This does not mean bad quality. It's because fermentation took place in the bag and the gases had no place to escape. All you have to do is keep the bag open and stir once a day. The odor will go away within days and the substrate will be ready to use two weeks later. To be safe, it is best to ventilate decayed vegetation from bags with holes as well. Open the bag and stir once a day for seven days before use. Some hobbyists like to mix different kinds of decayed vegetation. For



亡。為了安全起見，包裝已經事先戳洞的腐植物最好也是透氣一個星期後再使用。另外要注意的一點是，有些飼育家喜歡混合腐植物，比如說把一些朽木屑混到腐植土中，如此一來可以延長換飼料的時間。這麼做並無不妥，但很有可能產生二次急速發酵。也因此，為了安全起見，剛混合好的食材不要立刻拿來飼養幼蟲，以免發生幼蟲被熱死或是被廢氣毒死的情形。如果要在已經飼有幼蟲的腐植物中混入新的食材，則每3天只添加不超過原腐植物10%的新食材，並且注意是否有發酵的情形。

example, adding decayed wood flakes to flake soil. This can delay substrate change. However, this could also lead to another round of rapid fermentation. To be on the safe side, mixed decayed vegetation should not be offered to larvae immediately. Wait at least two weeks. It's possible to add new substrate to old substrate already containing larvae. However, add no more than 10% of the original volume in any three-day period.



↑ 菇農種完香菇後丟在一旁不要的軟朽木。對他們雖是垃圾對我們可是珍寶！1999  
Abandoned decayed wood at a mushroom farm. Although decayed logs are useless to mushroom growers, they are priceless to us!



↑ 甲蟲專賣店販售的硬朽木。2007  
Hard decayed wood for sale.



↑ 各種品牌的腐植物。2007  
Various brands of decayed vegetation.