Protocol for estimating density of woody debris

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Equipment to the field (in addition to what is needed for estimating nominal volume) (Fig. 1)

1) Chainsaw (blade length at least 650 mm)
2) Hand saw with stiff blade
3) Hand pruner
4) Ax
5) Portable balance (0-3 kg)
6) Wireless drill
7) Hole saw (preferably approximately 10 mm in diameter and at least 40 mm long)
8) Leather gloves (to avoid stings of animals)
9) Plastic bags of various sizes

General procedure in the field

The density of woody debris (dry mass per fresh volume) is estimated in conjunction with the estimation of nominal volume. All pieces of woody debris matching the criteria to be included in the estimation of nominal volume are sampled for density of woody debris from every fifth transect starting from the third most westerly transect.

Take the samples after determining at the intersection of the transect and the central axis of the piece and recording the diameter, decay stage, angle and presence of leaves and bark as described in the protocol of estimating nominal volume of woody debris. The sampling depends of the diameter and solidity / friability of the woody debris.

1) For relatively solid pieces of woody debris with a diameter of 20-299 mm cut a disc/slice of approximately 10 mm thick with either chainsaw (Fig. 2), hand saw or hand pruner. Measure with a small caliper the thickness at random point of the edge of the disc. If there is a doubt that the thickness varies at the edge by more than 10 % measure the thickness in addition to the random point of the edge also in the opposite side of the edge and record the average. After thickness measurement pack the sample tightly in a plastic bag and carry it to the laboratory. Pieces that have broken off from the disc should naturally also be packed in the bag. If the distance to carry the samples is long or the capacity of drying ovens is limited, you can set a lower higher

diameter limit for pieces to be carried to the laboratory (in stead of 299 mm e.g. 99 mm). This lower limit should be followed consistently for the plot in question.

2) For relatively solid pieces of woody debris with a diameter of 300-1249 mm cut a disc approximately 30 mm thick with a chainsaw and weight it with a portable balance. Place the disc horizontally and determine and mark with the marking crayon or chalk the approximate centroid (not the pith) of the disc. Use the measuring tape to mark points every 100 mm along a transect halving the disc. Cut small samples from the marked points with a hole saw and measure their length to estimate the thickness of the disc (Fig. 3). Pack the small samples tightly in separate plastic bags and carry them to laboratory. Potential problems and solutions are:
   a) Sawing a disc of even thickness from a very large piece of woody debris is challenging. If the diameter of the piece is greater than the length of the blade of the chainsaw, up to nine cuts need to be made (Fig. 4). If despite of careful sawing the disc is not evenly thick and its thickness does not change gradually you should take samples every 200 mm but along two perpendicular transects (four directions from the centroid)
   b) If the disc breaks before samples are taken simply assemble the pieces and work out the locations of the points for sample taking.
   c) If the disc is too heavy to be weighted in one piece, break it before weighting. To simplify the procedures mark the points for sample taking before breaking the disc with an ax.
   d) If the combination of a drill and hole saw is incapable of penetrating the wood, you can take the samples with an ax (Fig. 5).

3) For friable pieces of woody debris of 20-1249 mm in diameter from which cutting a solid disc is impossible make two parallel cuts to extract a section of approximately 100 mm long into one or several plastic bags. Record the exact length of the piece by measuring it directly with a caliper of if it is too friable measure the length of the gap and subtract the width of the blade of the saw twice. Take great care to include all even small pieces in the following step.
   a) Carry the sample to the laboratory if the extracted woody debris is not too heavy.
   b) If the extracted woody debris is too heavy to be carried to the laboratory weight it (naturally subtract the weight of the bag) and put it in one big plastic bag. Mix it well before taking the sub-sample of 100-1000 g. To reduce the risk of getting an unrepresentative sub-sample it should be composed of several scoops from various parts of the bag.

4) For all pieces with a diameter of 1250 mm and over (there will possibly be none in the whole plot) make a hole on the more eastern side of piece and take a sample of 100-1000 g with the chainsaw at the depth of approximately 300 mm. Modify the sample with the hand saw or hole saw to make it symmetric (e.g. cylinder) and record its volume.

Equipment and procedures in the laboratory

1) Drying oven
2) Metal or paper cups
3) Balance (0.1 g accuracy)

Weight all samples to record the fresh mass. Dry them at 65ºC to constant weight and record the dry mass (Fig. 6).

Fig. 1. Some of the equipment needed on transects where samples are taken for density estimation. A much smaller ax is sufficient for this purpose. The drill should be powerful. The compass is needed also on transects in which only nominal volume is estimated. The diameter of the hole saw in the picture is too large as it cannot penetrate the strongest woods. The hand pruner is suitable for very small pieces of woody debris (diameter less than 30 mm). The protractor is needed also on transects in which only nominal volume is estimated. The hand saw is most useful to cut pieces of woody debris of 30-70 mm in diameter.

Fig. 2. Cut a disc perpendicularly to the central axis of the piece when looking from above and vertically when looking from the side.

Fig. 3. Take small samples with a hole saw of big discs that are too heavy to transport to the laboratory. Note that the photo was taken at the time of experimental drilling and the locations for taking the samples were not clearly marked as should be done.

Fig. 4. Up to nine cuts with a chainsaw might be needed to get a disc if the diameter of the piece of woody debris is larger than the length of the blade of the chainsaw.

Fig. 5. An ax is an alternative to the hole saw when the saw cannot penetrate the wood. Note that the photo was taken at the time of experimental cutting and the locations for taking the samples were not clearly marked as should be done.

Fig. 6. Drying the samples is necessary to be able to estimate the dry mass.