Noxious Weed Survey Results

There were no noxious weeds growing within the Biological Survey area. There are scattered individuals of common tansy (*Tanacetum vulgare*) occurring along roadsides near the boundary of the BSA. Tansy is a Class C weed (control not required).

Two other Class B noxious weeds were found on previous surveys within Mt. Spokane State Park, but outside the BSA (Smith 2009, Wooten and others 2009). These species are orange hawkweed (*Agoseris aurantiaca*) and Dalmatian toadflax (*Linaria dalmatica*). Monitoring and management of these noxious weeds was discussed in earlier reports. These species do not occur within the BSA at this point in time (based on our survey results). This is largely due to the fact that these species thrive on disturbance and largely inhabit open areas and the BSA is now mostly forested. It is quite possible that these species may spread within the Biological Survey Area if significant disturbance opens the canopy and disturbs the ground. Then, control measures for noxious weeds may be necessary.

Wildlife Habitat Survey Results

Our more detailed habitat surveys of the Biological Survey Area (BSA) were initially based on the polygon mapping and reconnaissance-level habitat data collected for the larger SEIS Analysis Area. Eighty four polygons in the SEIS Analysis Area overlapped or were included in the BSA. The BSA intersected some of the polygons in the SEIS Analysis area in a way that the original polygons were split into two parts or more. Since our more detailed habitat surveys in the BSA were somewhat independent of the reconnaissance-level work in the larger analysis area, we gave each split polygon part a new number. This resulted in a total of 92 polygons in the BSA (Figure 7).

As describe in the Methods section of this report, the polygons were each attributed with quantitative habitat information based on a combination of ecology plot data, other field survey information, aerial photo analysis and our expert judgment. One of the steps of this process was to analyze the forest habitat plot data and to interpolate this to the BSA landscape using an inverse distance weighted interpolation technique (Philip and Watson 1982, Watson and Philip 1985). An example of the result of this technique is shown in Figure 8, which illustrates the tallest trees in the forest stands within the BSA. This information is interpolated from recorded tallest tree in each plot, which is labeled in this illustration. Tree canopy height is a habitat variable that can influence many bird species, including the northern goshawk, which is an important bird of prey at Mt. Spokane.

All the detailed habitat information was compiled into a database, which was eventually transferred into a spatial database attached to a Biological Survey Area habitat polygon layer. Each polygon is attributed with 35 quantitative or descriptive habitat attributes. Some of the more important attributes are illustrated in maps in the following section of this report. All of the data for each polygon is summarized in the polygon descriptions that are presented in Appendix A.

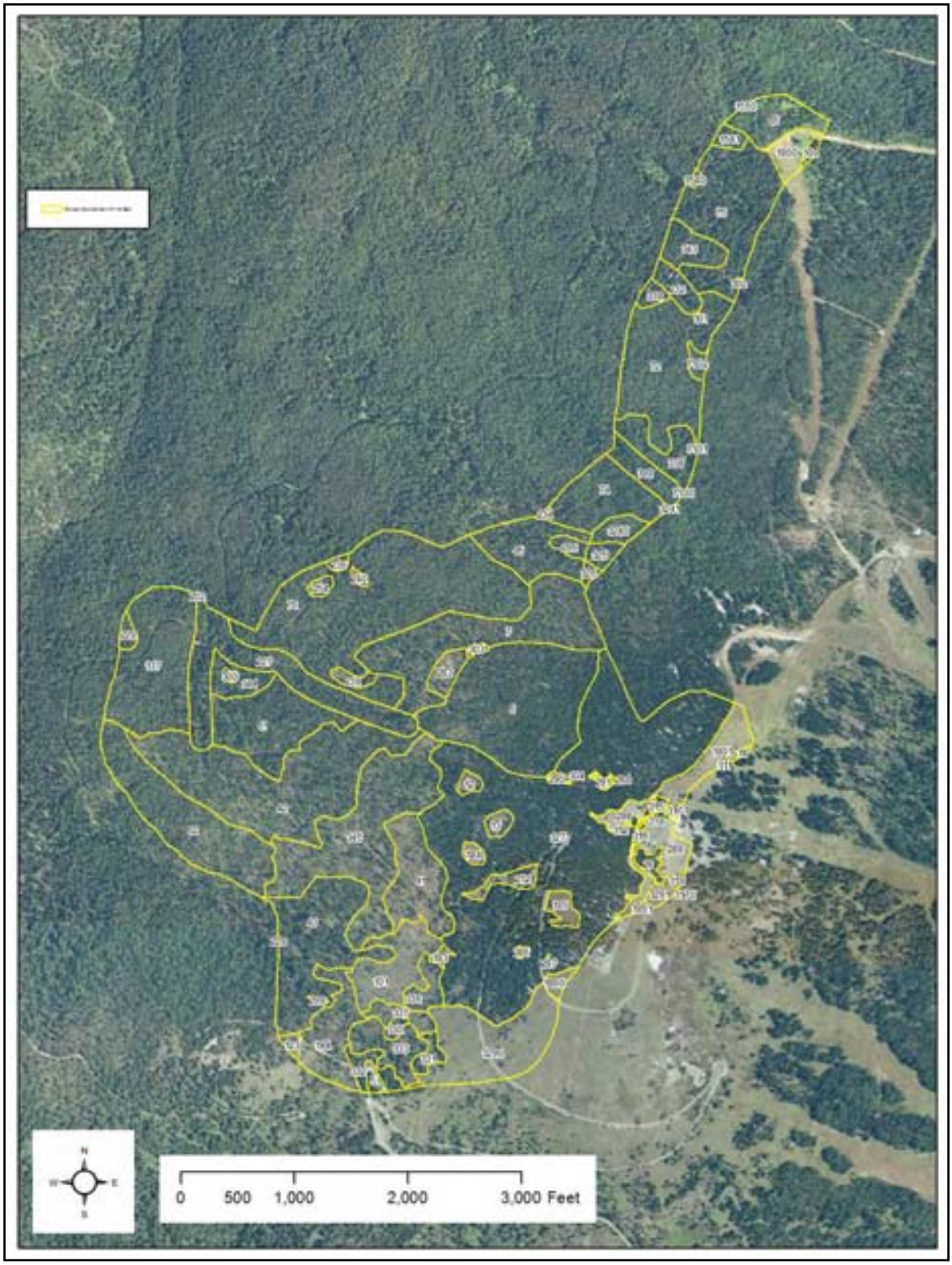

Figure 7. Habitat polygons within the Biological Survey Area.

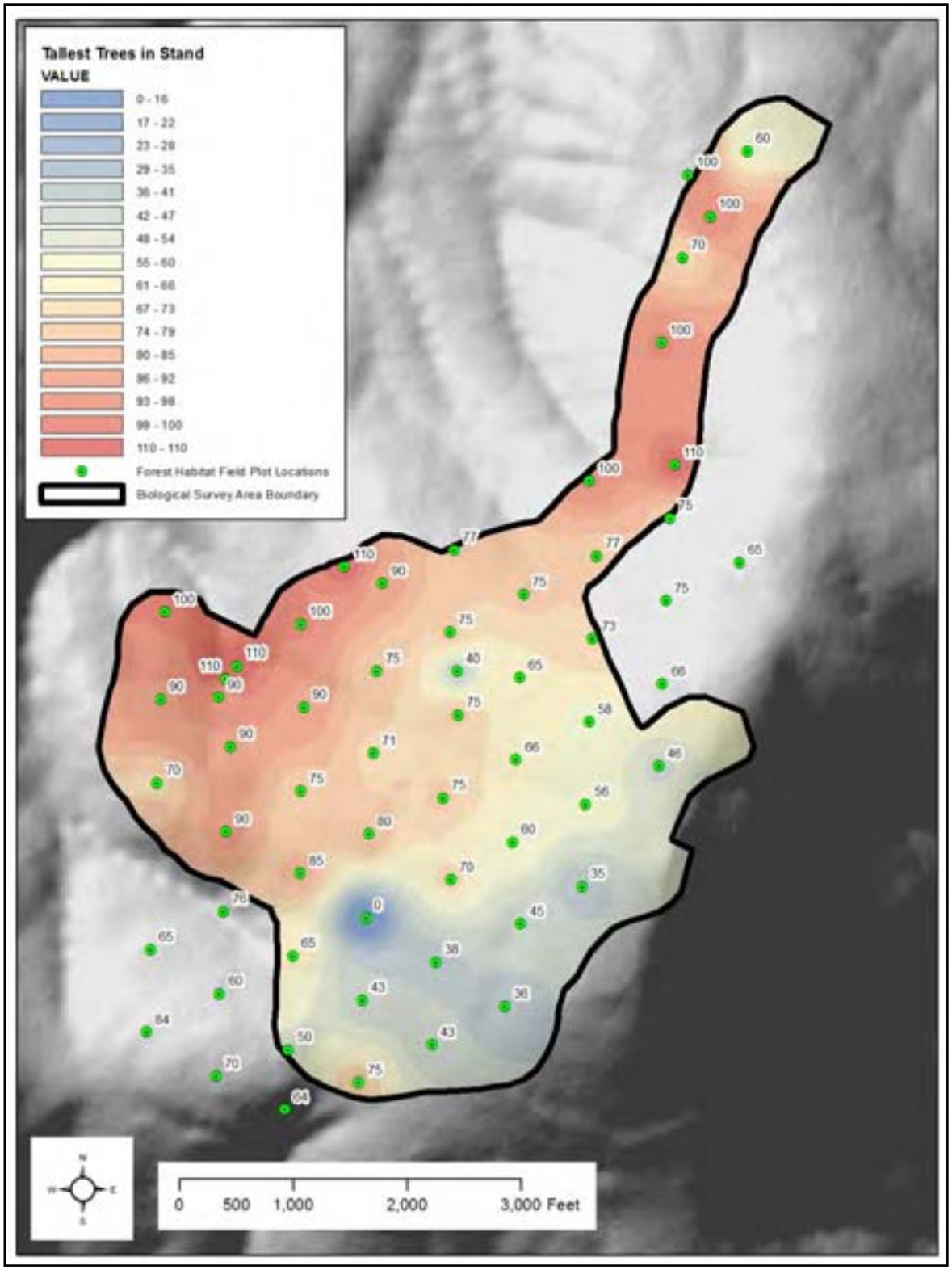

Figure 8. Tallest trees in the Biological Survey Area - an illustration of the IDW interpolation technique.

Detailed Wildlife Habitat Information for Polygons within the Biological Survey Area

This section of the report provides an example of some of the data contained within the Biological Survey Area (BSA) polygon database. All of this information is also included in the polygon descriptions that are presented in Appendix A. The following section is organized by major wildlife habitat themes.

Plant Associations

Field surveys identified 32 plant associations within the BSA, 22 of which were primary plant associations (PAs), including non-vegetative cover types such as talus, developed areas or ski runs. These are listed in Table 1 along with all other plant associations recorded within the SEIS survey area. Plant associations are a key habitat attribute for many wildlife species.

Table 6 lists the primary plant associations within the BSA, along with number of polygons and area covered by each. The distribution of primary plant associations is illustrated in Figure 9.

Table 6. Area and number of polygons within the BSA covered by the 22 primary plant associations.

PA	No. Polygons	Acres
ABGR/ACGL/CLUN2	2	22.4
ABGR/VAME	1	0.8
ABGR/VAME/CLUN2	2	1.1
ABLA/ATFI	2	2.2
ABLA/LUGLH	1	2.4
ABLA/MEFE	4	44.0
ABLA/TRCA	1	0.3
ABLA/VAME	5	9.7
ABLA/XETE	29	260.4
ALVIS/ATFI	1	0.1
ALVIS/Mesic Forb	3	1.9
ALVIS/SETR	1	4.8
Developed	3	9.7
ERUMM-FEVI	2	15.6
FEVI-FEID	5	4.9
PHDI3/FEVI-HICY	1	0.4
Talus	6	5.8
TSHE/ATFI	5	11.1
TSHE/CLUN2	11	42.7
TSHE/GYDR	2	15.4
TSHE/MEFE	3	15.9
TSHE/XETE	2	18.8
TOTAL		**490.4**

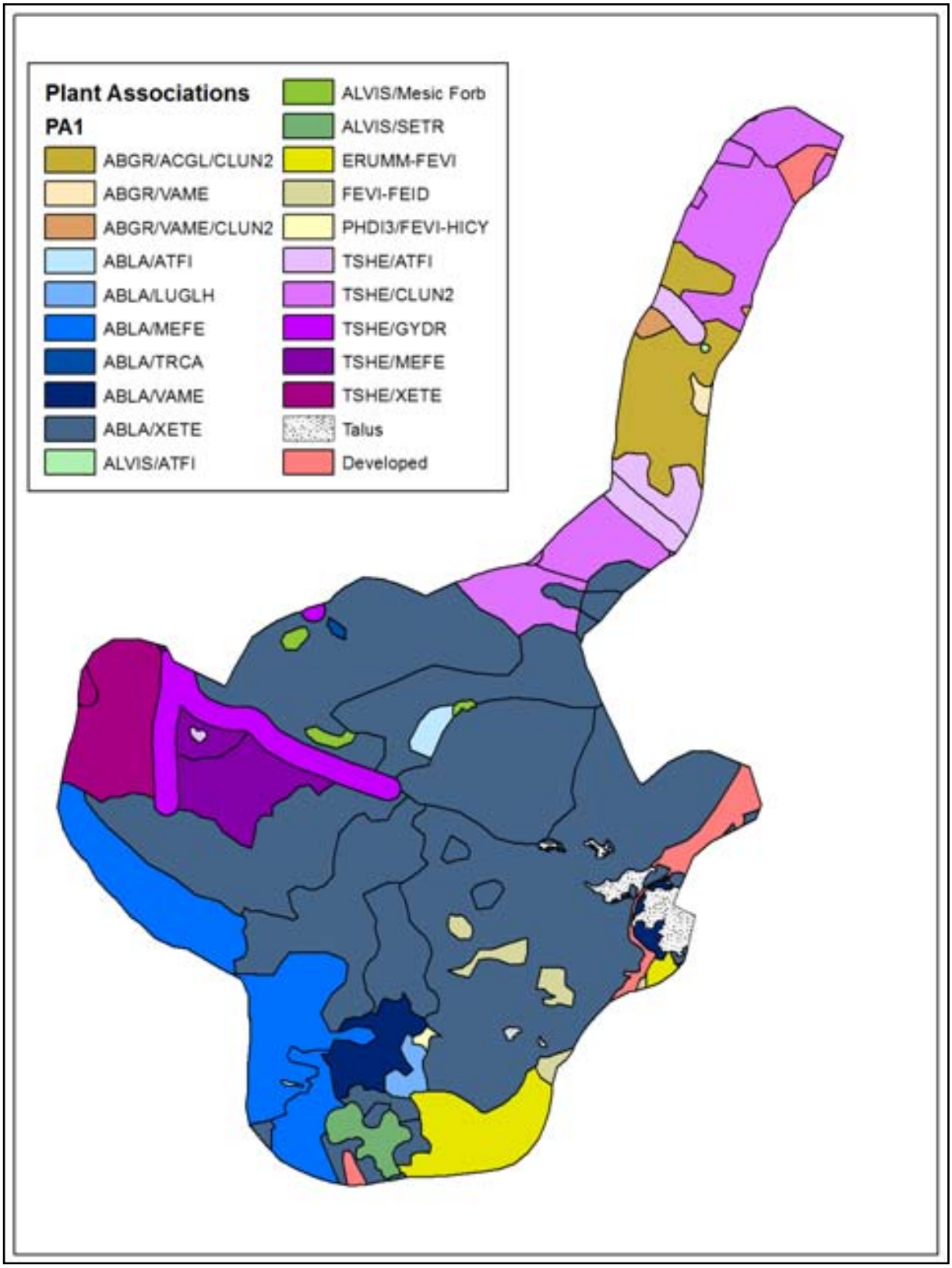

Figure 9. Primary plant associations within the BSA.

Forest Canopy Layers and Cover

Forest canopy cover (Figure 10) represents the amount of the sky that is covered by a forest canopy. It is one of the most important indicators of forest condition and determines the amount of light that reaches understory vegetation. This is an important habitat determinant for many wildlife species. The number of forest canopy layers is also an important habitat attribute for many wildlife species (Figure 11). Similar to total canopy cover is an estimate of the total tree cover (Figure 12). This can differ from canopy cover in that tall shrubs are excluded while small trees are included.

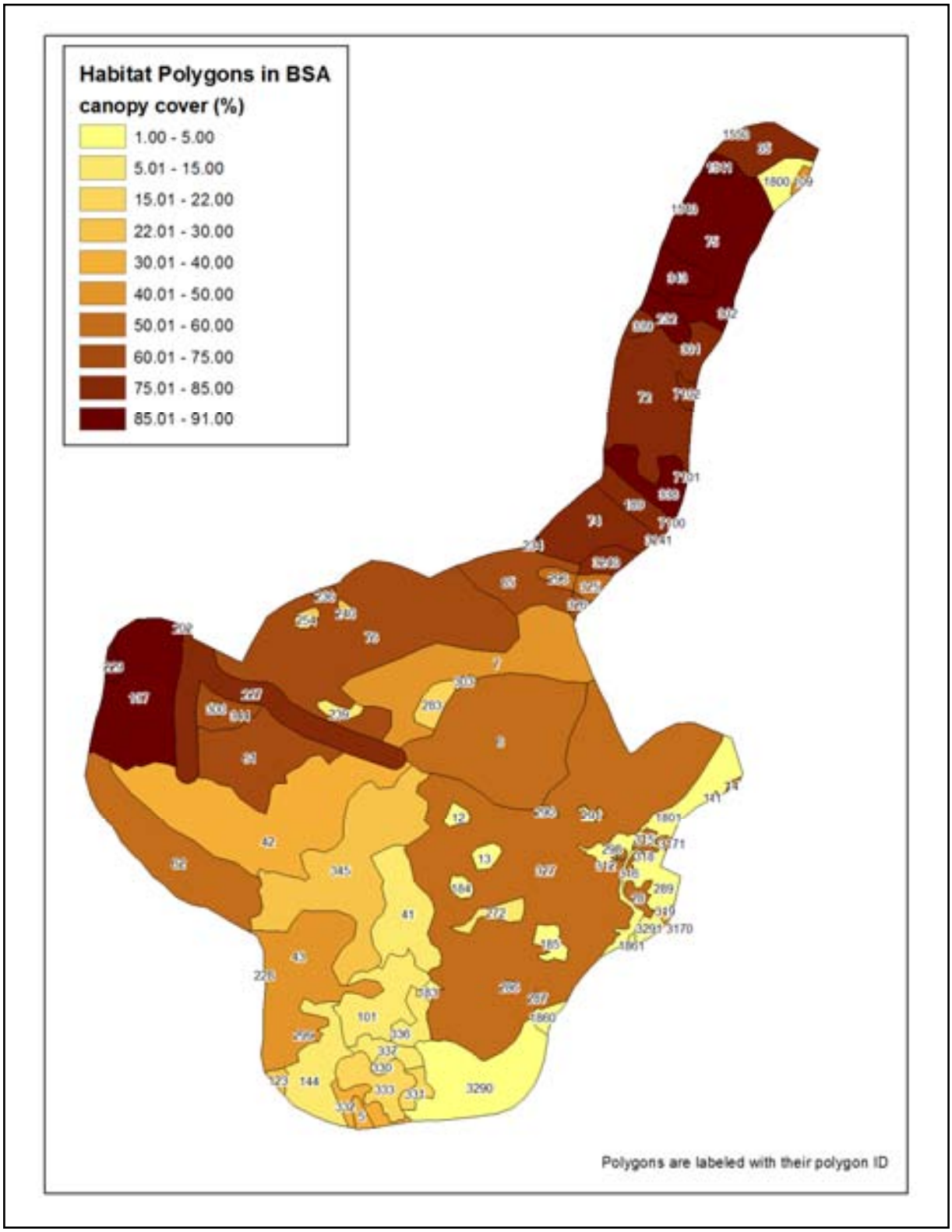

Figure 10. Forest canopy cover in BSA.

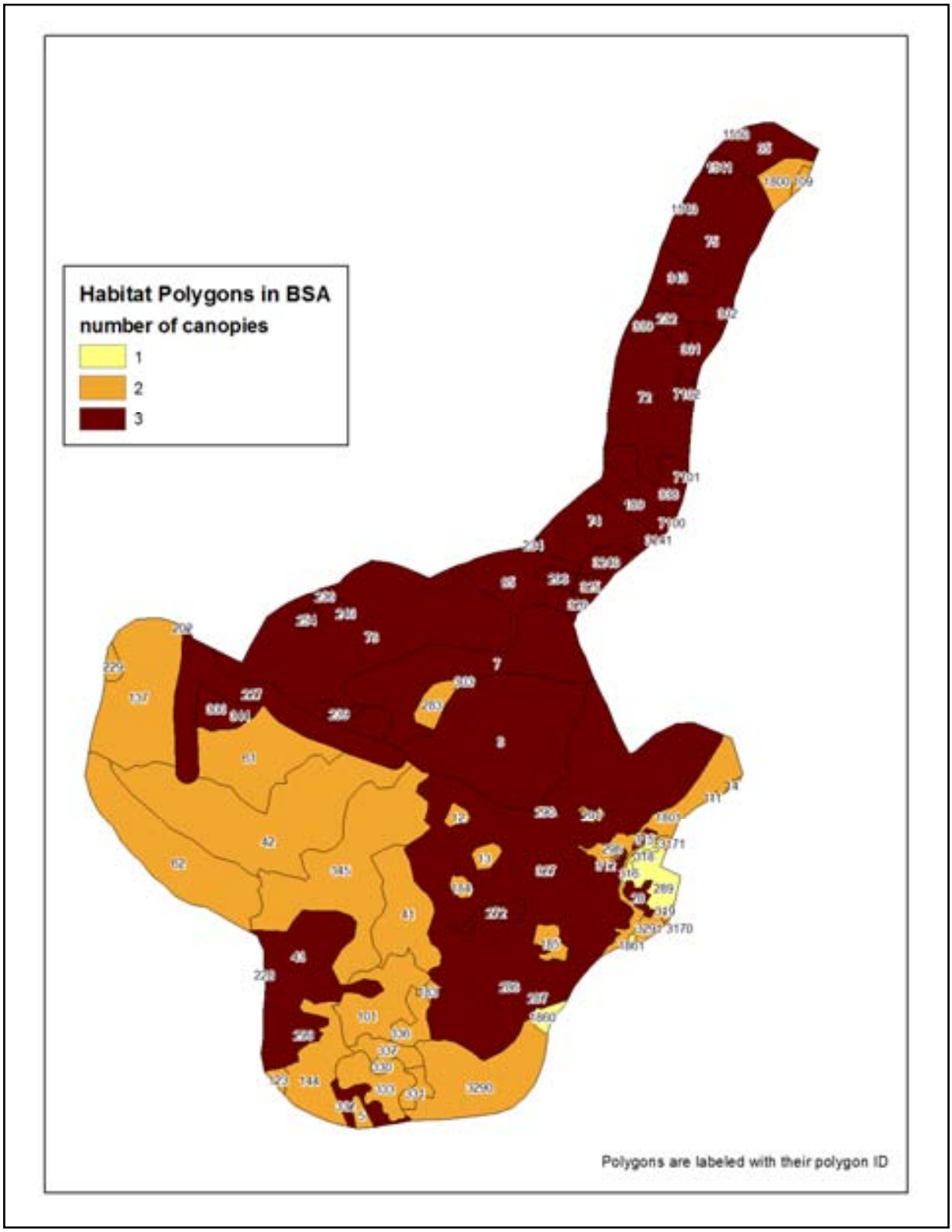

Figure 11. Number of canopy layers in BSA.

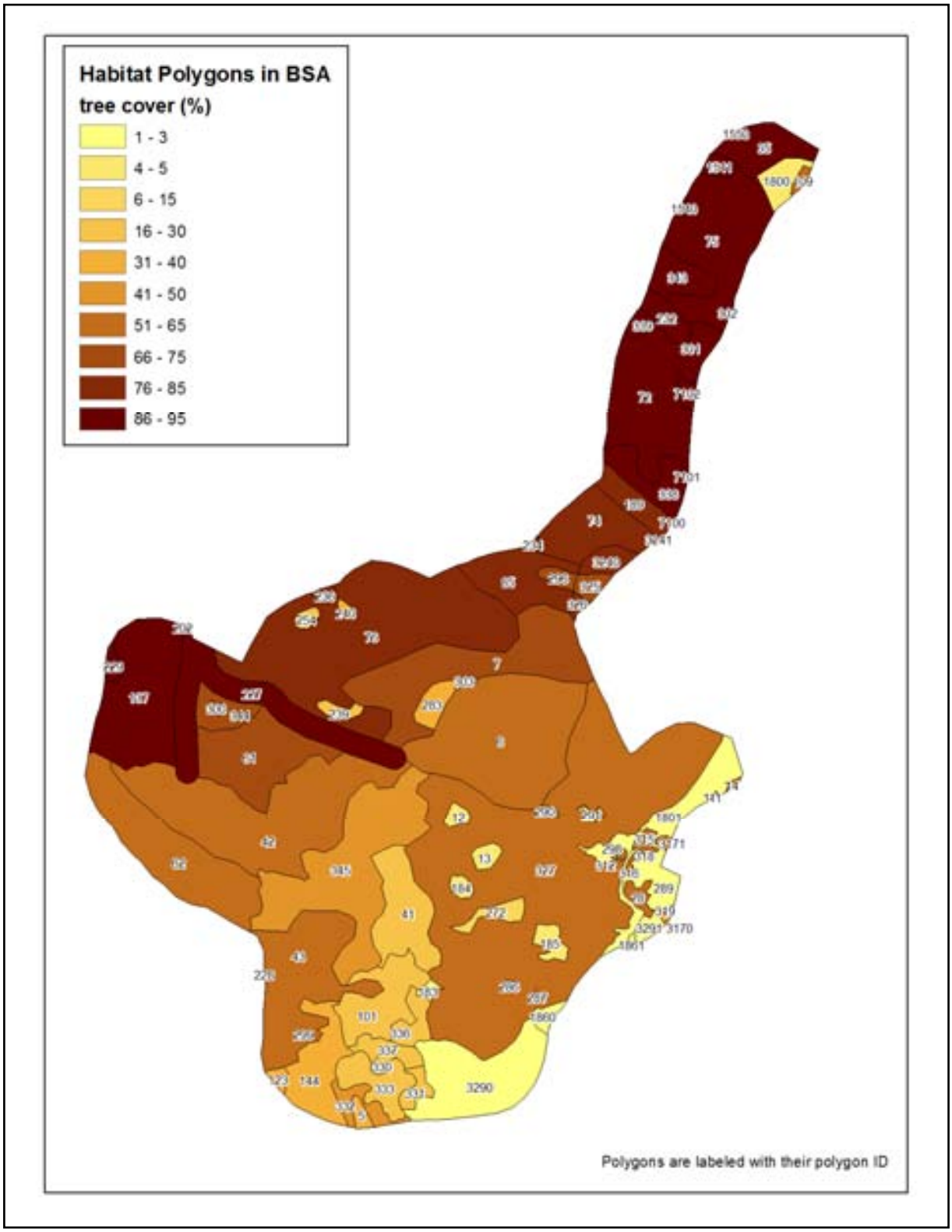

Figure 12. Total tree cover in BSA.

Tree Diameters

Large diameter trees (> 20 inches DBH) are very important habitat for many wildlife species. The BSA has a wide range of tree diameters. The size of the biggest trees in each polygon in the BSA is illustrated in Figure 13. Many polygons have at least some trees that exceed 20 inches DBH. These forest stands contain at least minimal habitat conditions for species that depend on large trees for all or part of there life stages.

In addition to the presence of individual large trees, we also assessed whether there were sufficient large trees per acre in a polygon to come close to approximating old growth forest conditions. Old growth forest conditions are optimal for some wildlife species. We consider the stands containing a density of over 8 trees per acre of trees that are over 20 inches DBH to meet one of the most important old growth forest attributes. Figure 14 illustrates the maximum diameter (maxdbh) of the trees in a stand that comprise a density of 8 trees (or more) per acre of that diameter class. The polygons that have maxdbh of 20 inches DBH or higher should be considered as potential old-growth forest. These stands usually have the best habitat conditions for wildlife species that depend on old-growth or late-successional forest conditions.

Quadratic mean diameter is another expression of the size and age of a forest stand. The quadratic mean diameter is the diameter of the tree with the arithmetic mean basal area (cross-sectional area) (Husch et al 1982). We calculate the quadratic mean diameter based on all the trees sampled in a variable radius plot. It is a more meaningful measure of the stand diameter than the simple mean diameter and is illustrated in Figure 15. Stands with a high quadratic mean diameter are also a sign that the stand is approaching old growth forest condition and that it has many of the habitat attributes needed by wildlife species that depend on late-successional forest conditions.

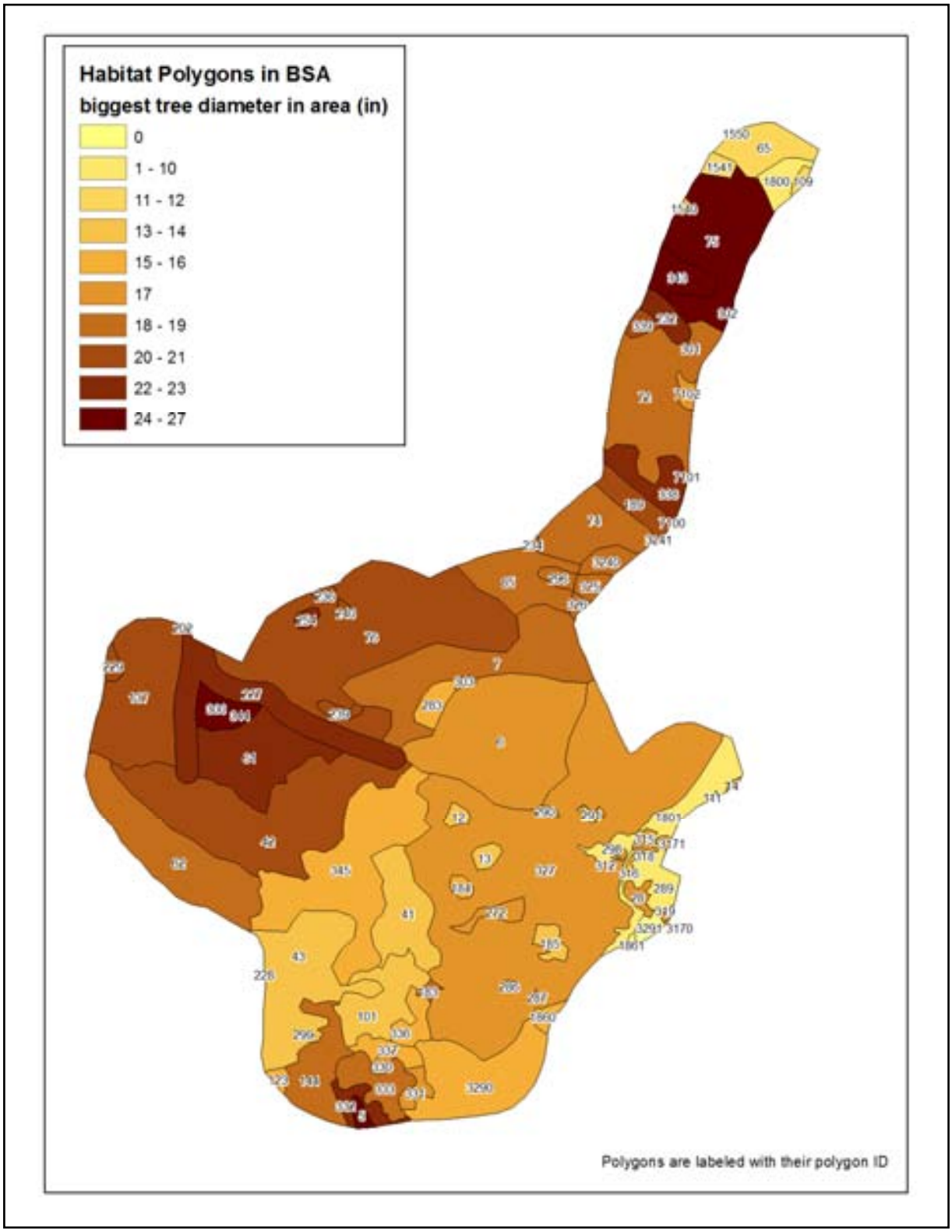

Figure 13. Diameter of biggest trees in the stands in the BSA.

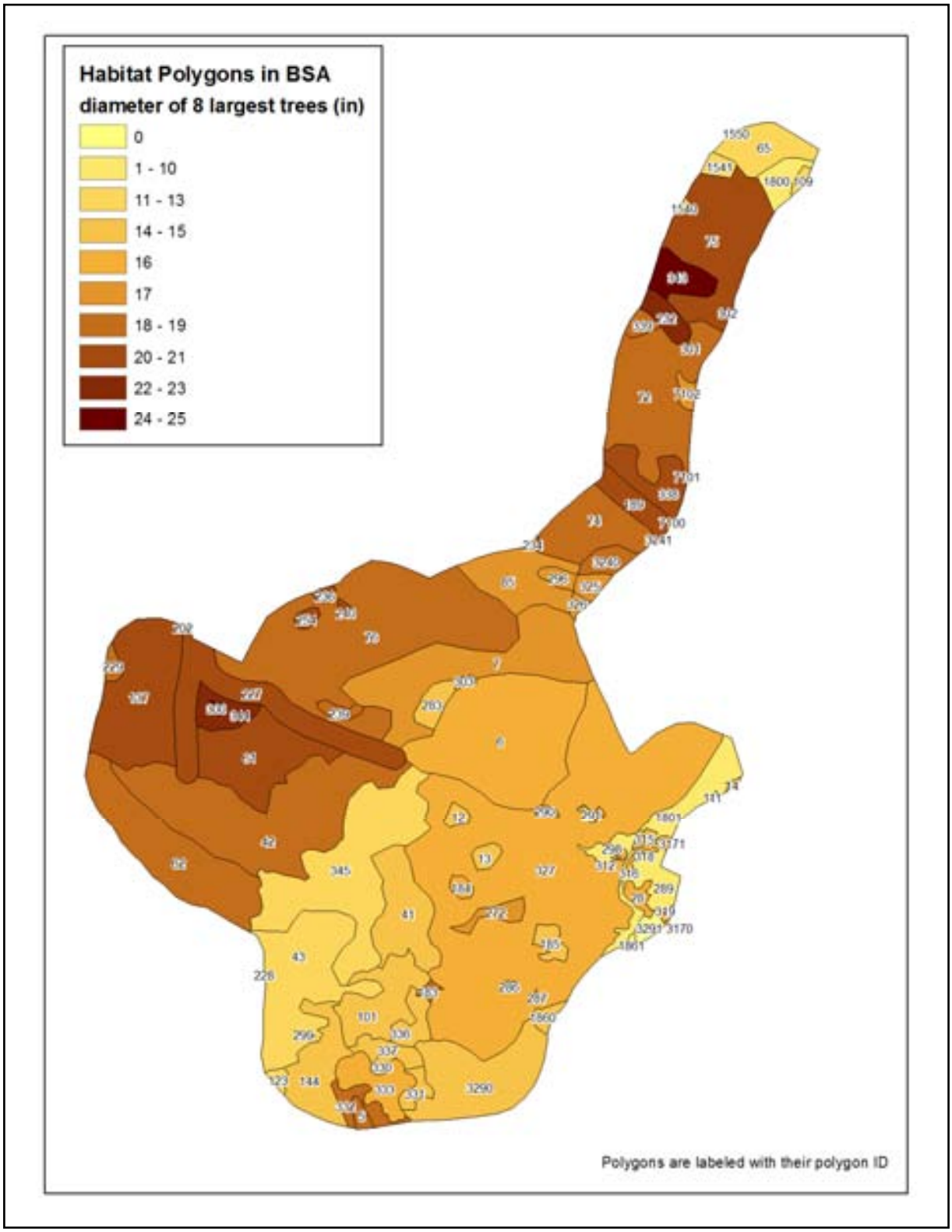

Figure 14. Diameter of the 8 largest trees in the stands in the BSA (maxDBH).

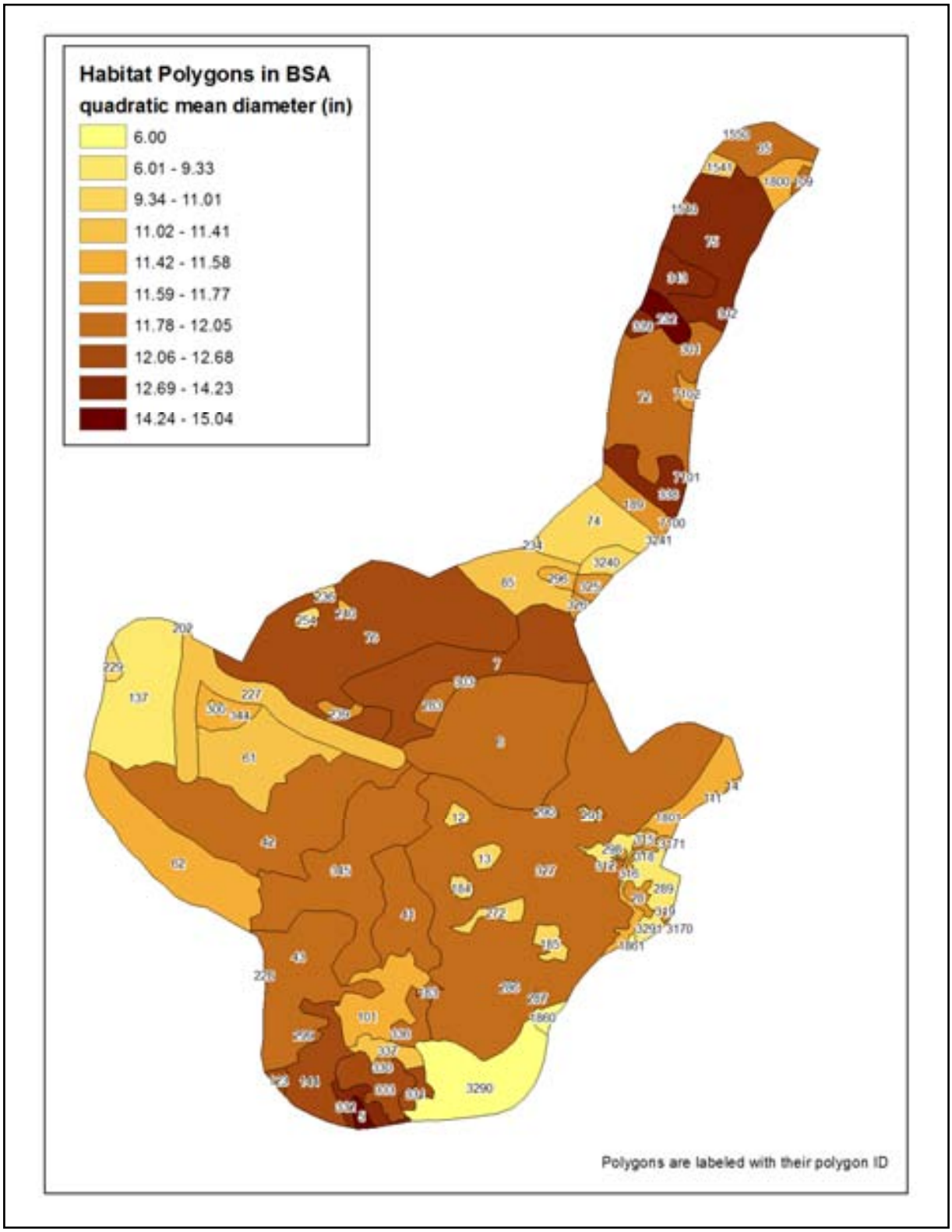

Figure 15. The quadratic mean diameter of the trees in the stands in the BSA (qmd).

Tree Density

The density of trees in a stand (stem density) is another important measure of forest condition and wildlife habitat. It is calculated by determining the number of tree stems per unit area (Figure 16). Our calculation of tree density was based on trees sampled in the variable radius plots, and so it does not include trees less than 6 inches DBH. High-density stands often have intense competition between trees for sunlight, water and nutrients. This often results in eventual mortality of the less competitive trees. Low-density stands often have ample room for trees to grow, however there may be very dense shrub understories and intense competition in the understory. Wildlife often prefer the less dense stands.

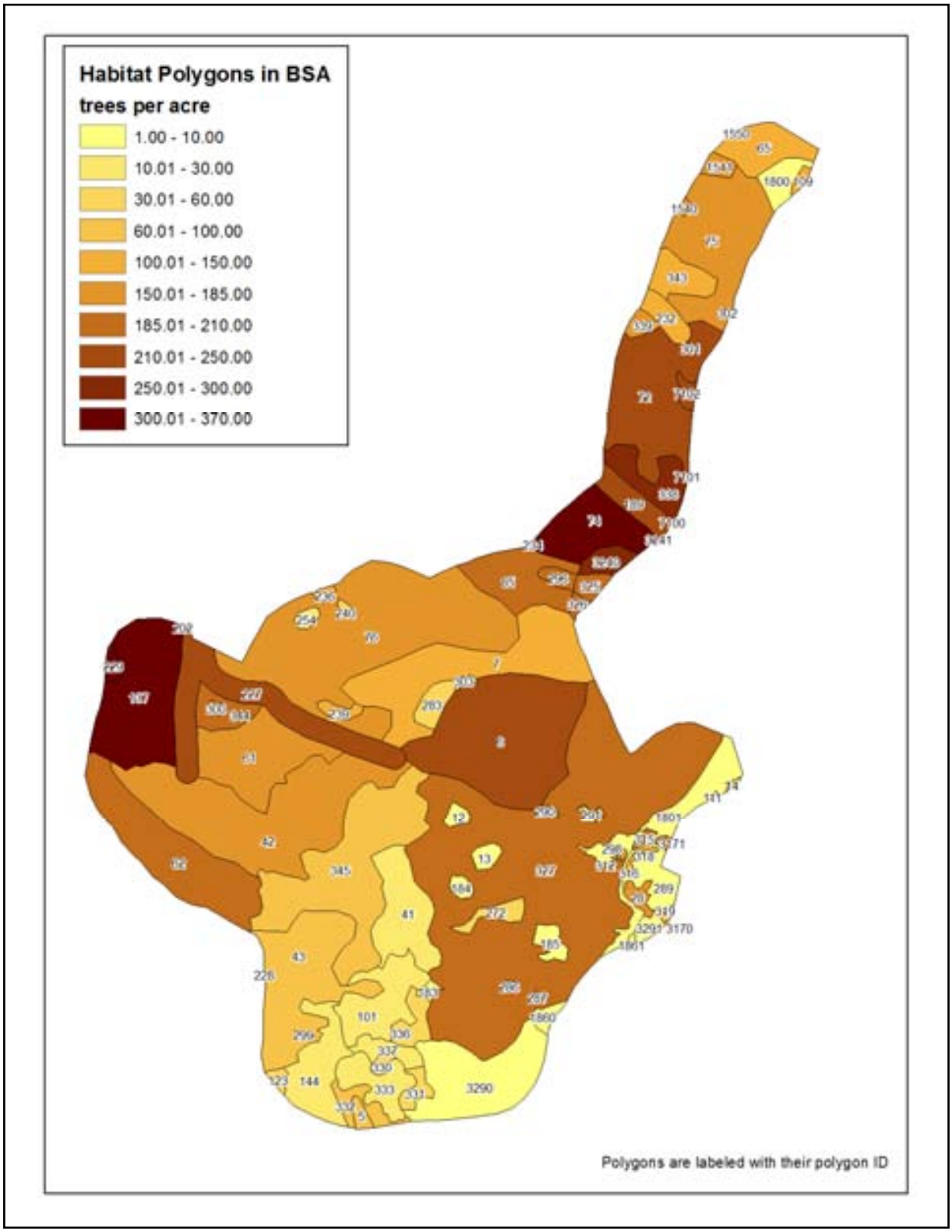

Figure 16. The number of trees per acre in the stands in the BSA (tpa).

Canopy Height

The forest canopy height is an important factor for some wildlife species. This is illustrated by maps of both the tallest trees in the stands (Figure 17) and the average tree height (Figure 18)

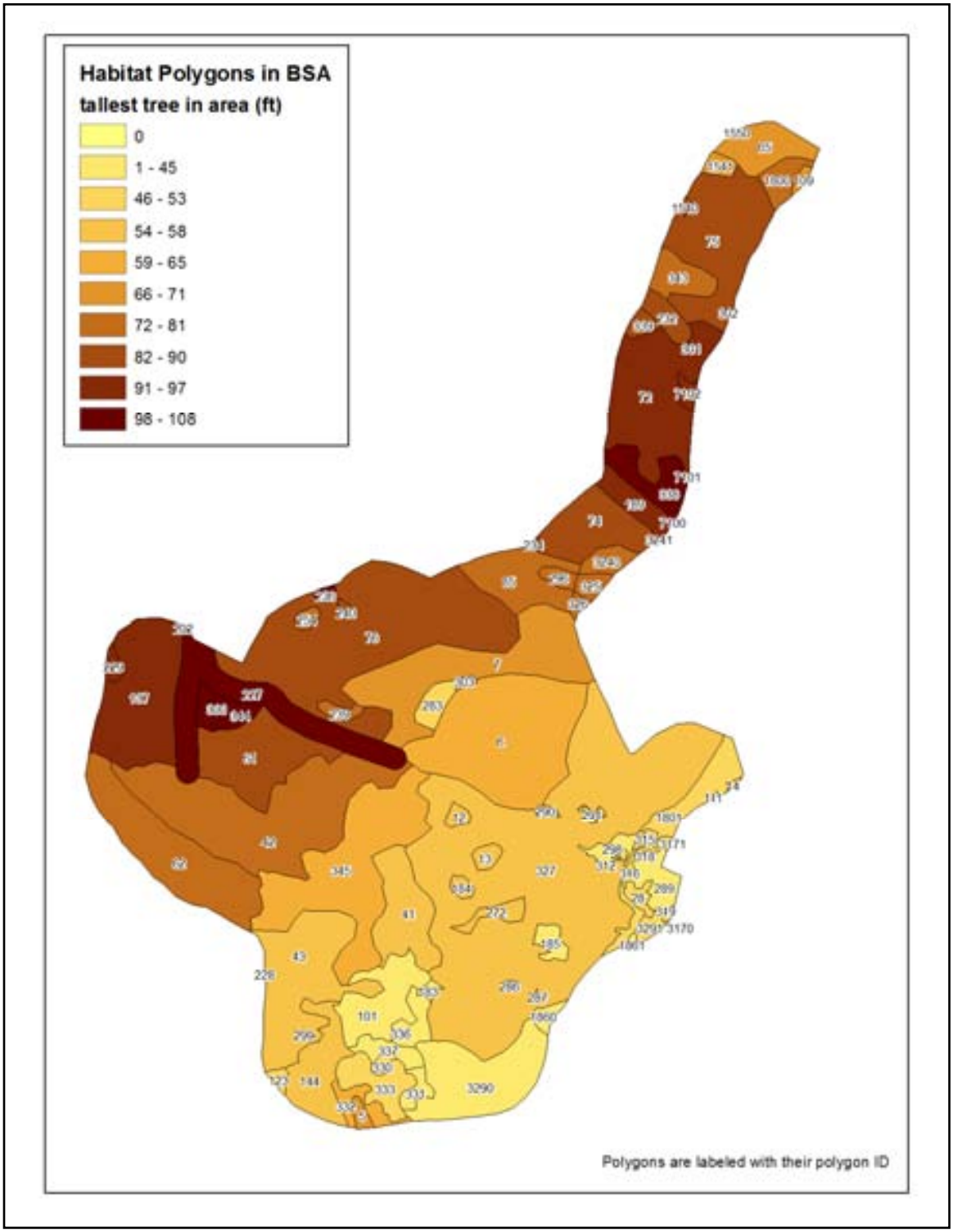

Figure 17. The tallest trees in the stands in the BSA.

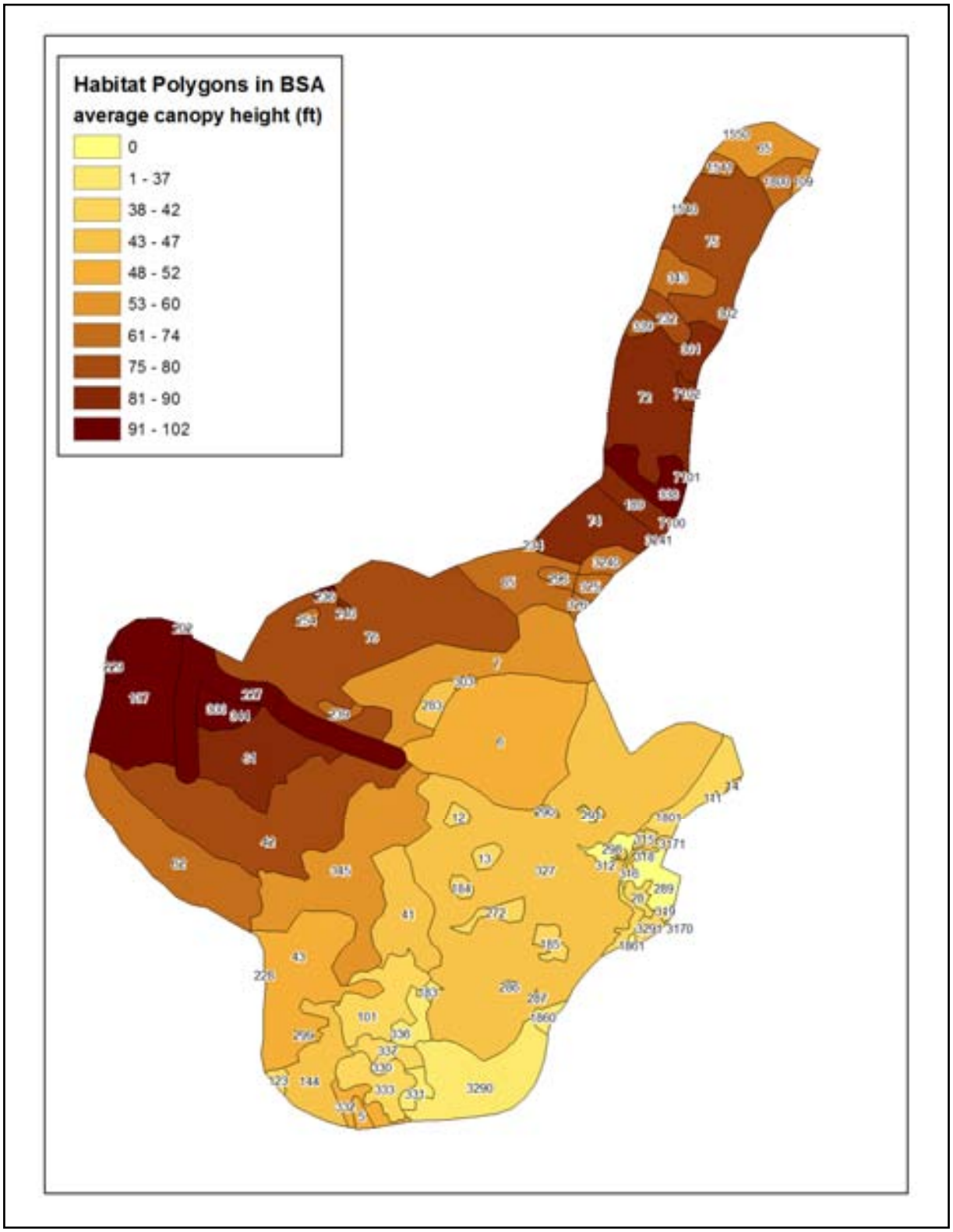

Figure 18. The average tree height in the stands in the BSA.

Basal Area

Basal area is simply a measure of the cross-sectional area of each stem, in this case the stems of the live trees. We calculated the basal area of each tree and then summed these values on a per acre basis for each forest survey plot. Figure 19 illustrates basal area as it varies throughout the project area as determined by IDW interpolation from the plot data. Basal area is one of the factors that determine the total biomass in a forest stand.

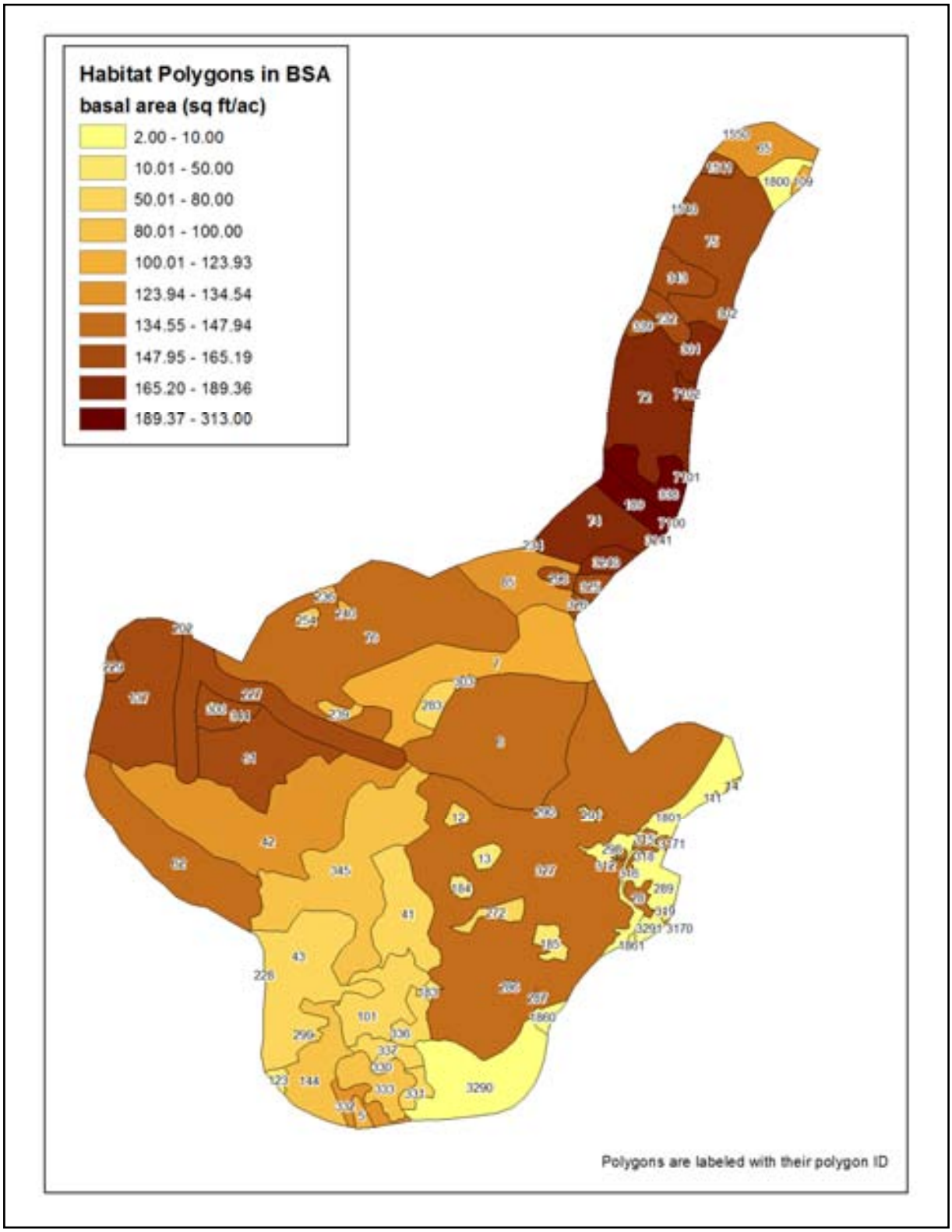

Figure 19. The basal area of the stands in the BSA.

Stand Density Index

Stand density index (SDI) is a measure of relative stand density, allowing comparisons between stands comprised of different species and diameters (Husch et al 1982). We calculated SDI using a new method developed by Woodall and Miles (2004) from our plot data and the result is depicted in Figure 20. Stand density index (SDI) was originally developed for use in even-aged monocultures, but has been used more recently for stand density assessment in large-scale forest inventories. Woodall and Miles (2004) improved the application of SDI in uneven-aged, mixed species stands present in large-scale inventories, through development of a model whereby a stand's maximum SDI was calculated as a function of the stand's mean specific gravity (SG) of individual trees.

SDI is usually not strongly correlated with age or site index. This quality of independence of age and site makes SDI a valuable parameter in describing a stand. It can be an important metric for determining wildlife habitat for some species.

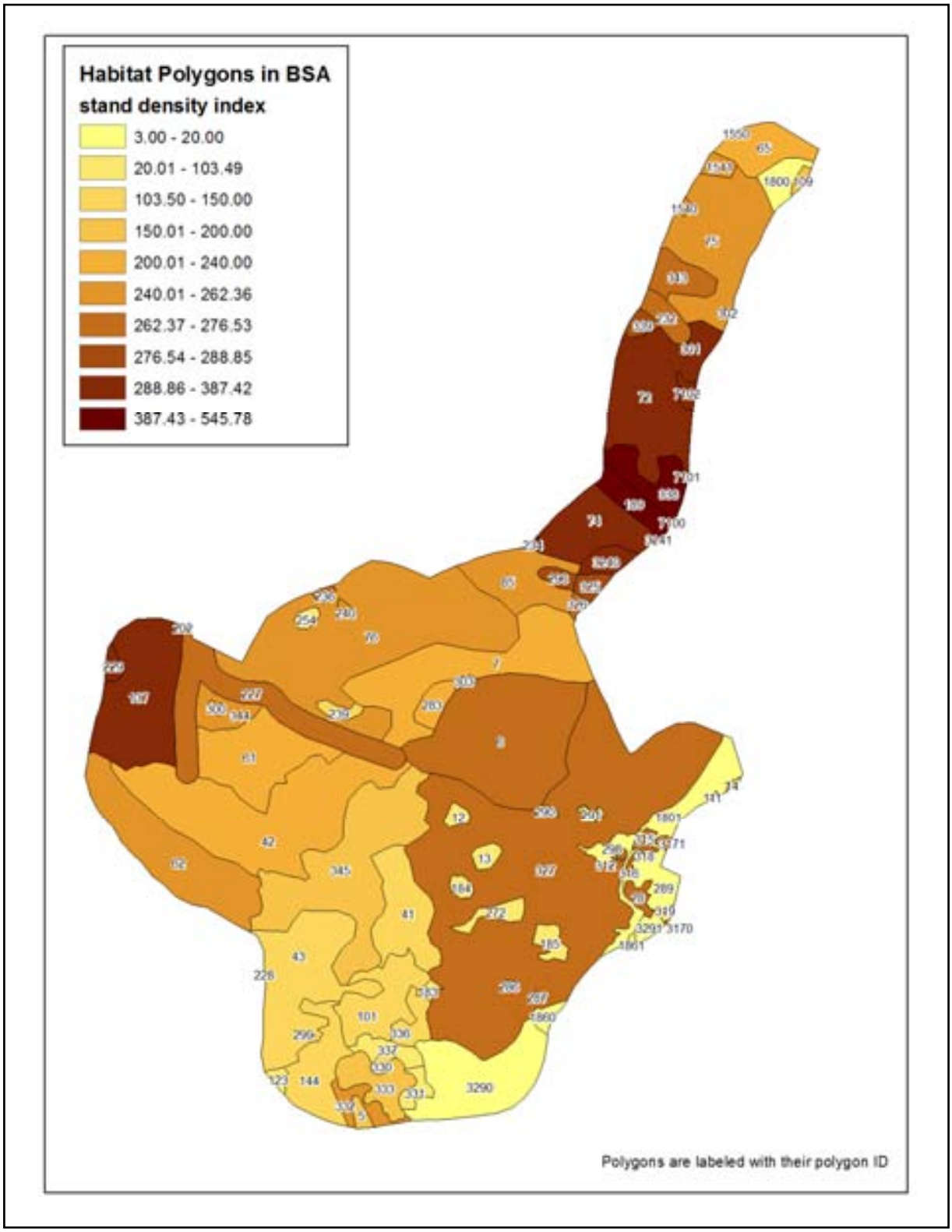

Figure 20. The stand density index of the stands in the BSA.

Shrub and Herbaceous Cover

The amount of shrub cover and herbaceous cover can be important determinants for many wildlife species. These wildlife habitat attributes are illustrated in Figures 21 and 22.

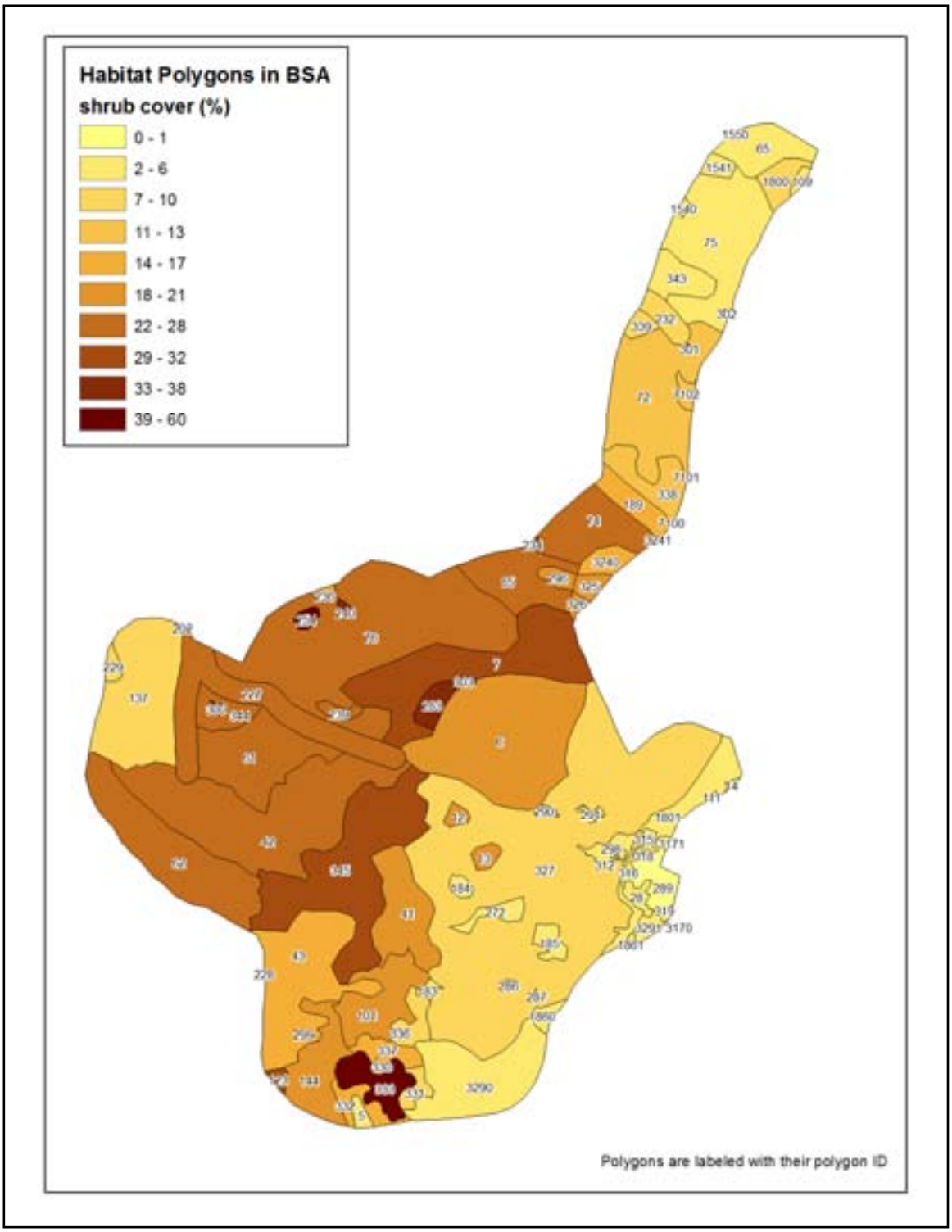

Figure 22. The shrub cover in the stands of the BSA.

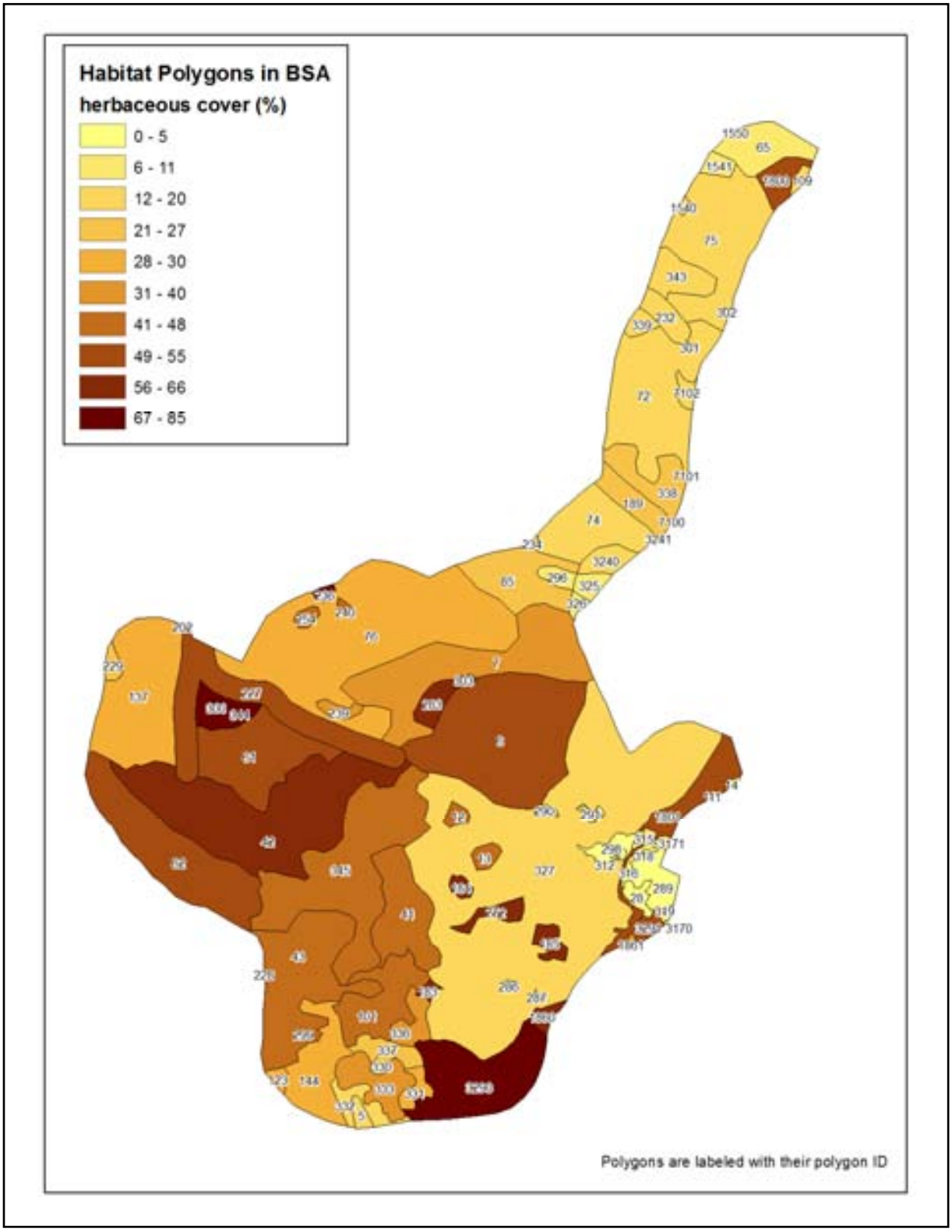

Figure 22. The herbaceous cover in the stands of the BSA.

Snags and Coarse Woody Debris

The presence of large snags and abundant coarse woody debris is critical to the survival of many wildlife species. The size and distribution of snags is illustrated in Figures 23, 24 and 25. The amount and distribution of coarse woody debris is illustrated in Figures 26 and 27.

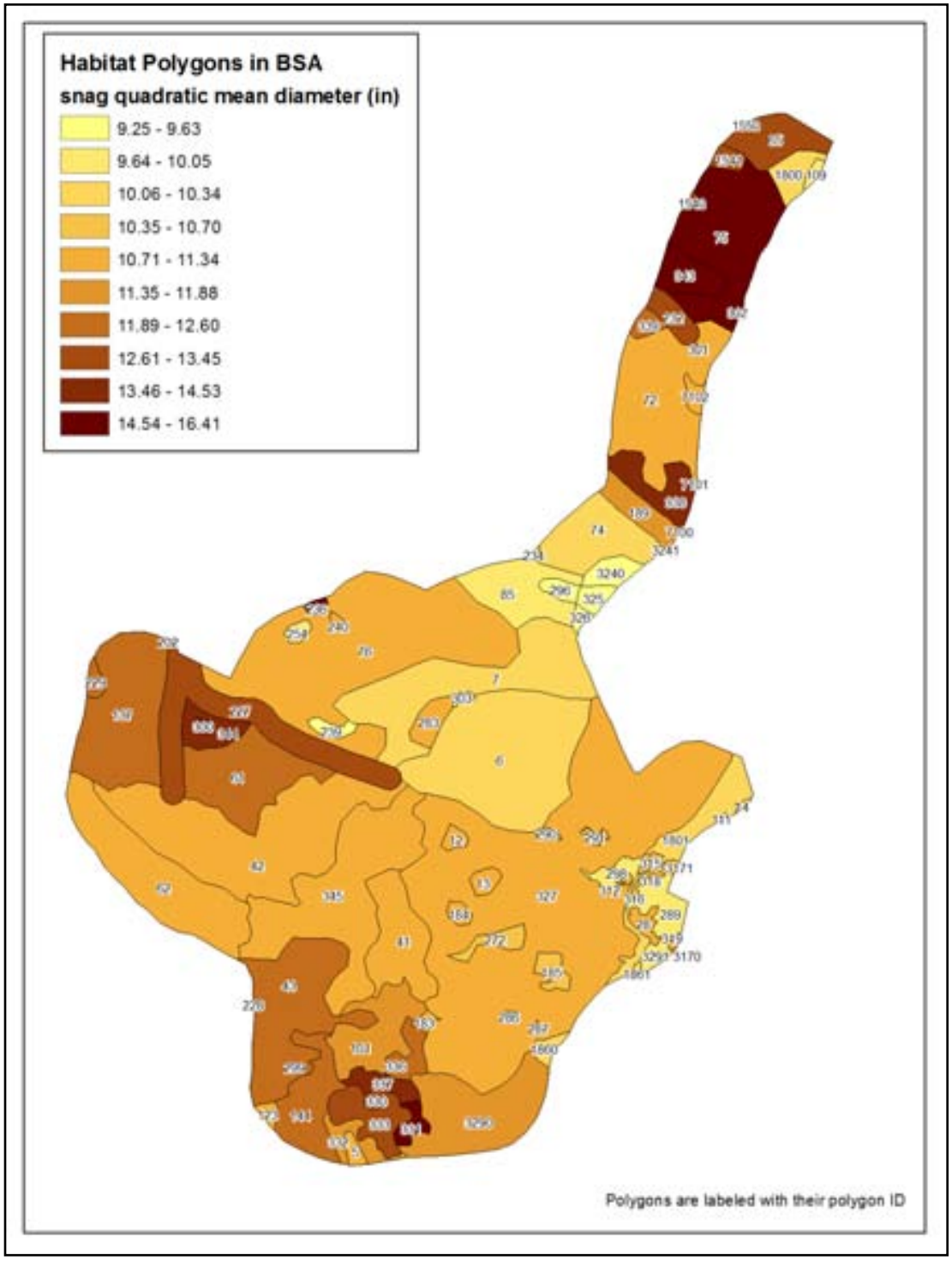

Figure 23. The quadratic mean diameter of snags in the stands of the BSA.

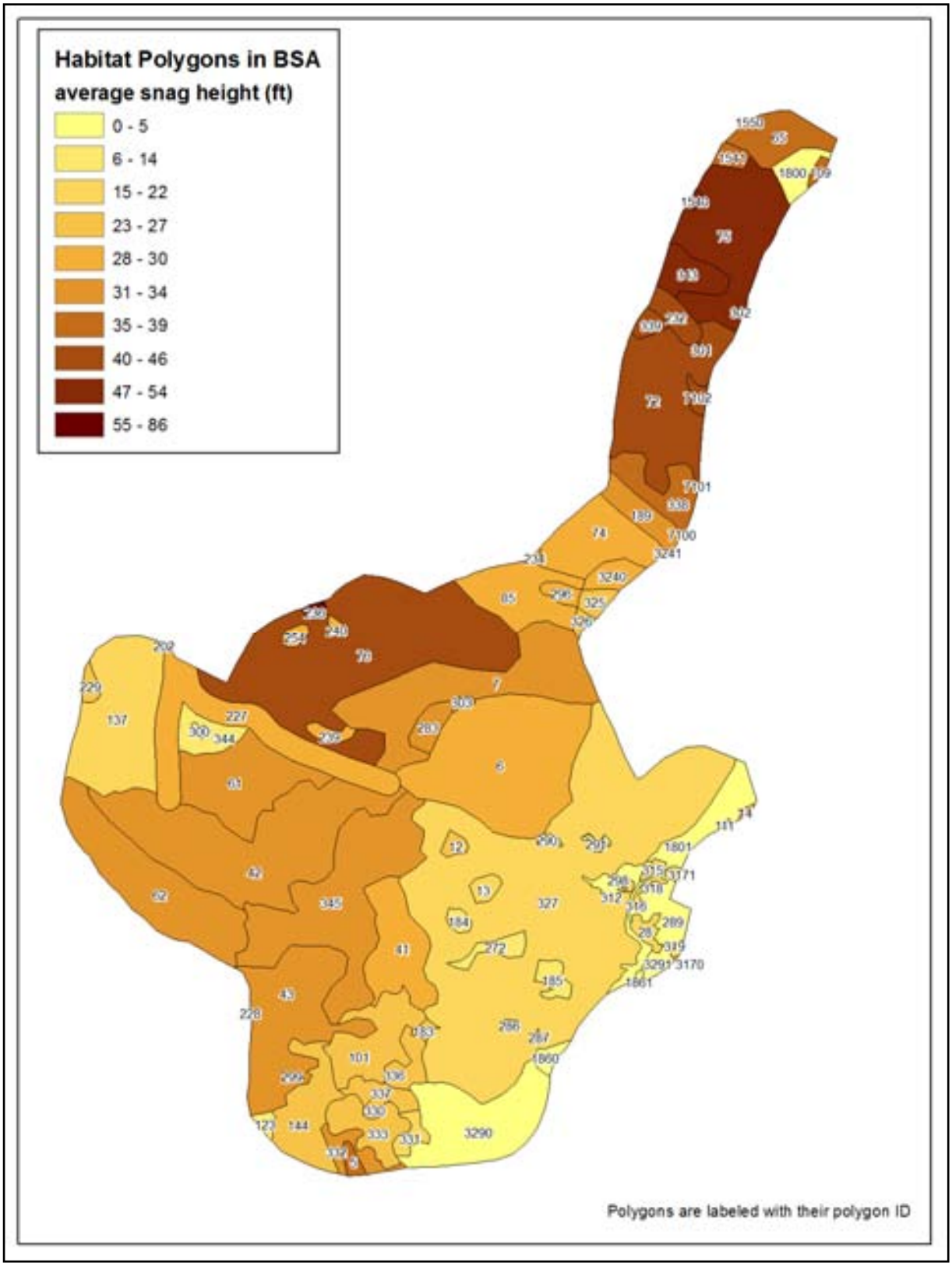

Figure 24. The average height of snags in the stands of the BSA.

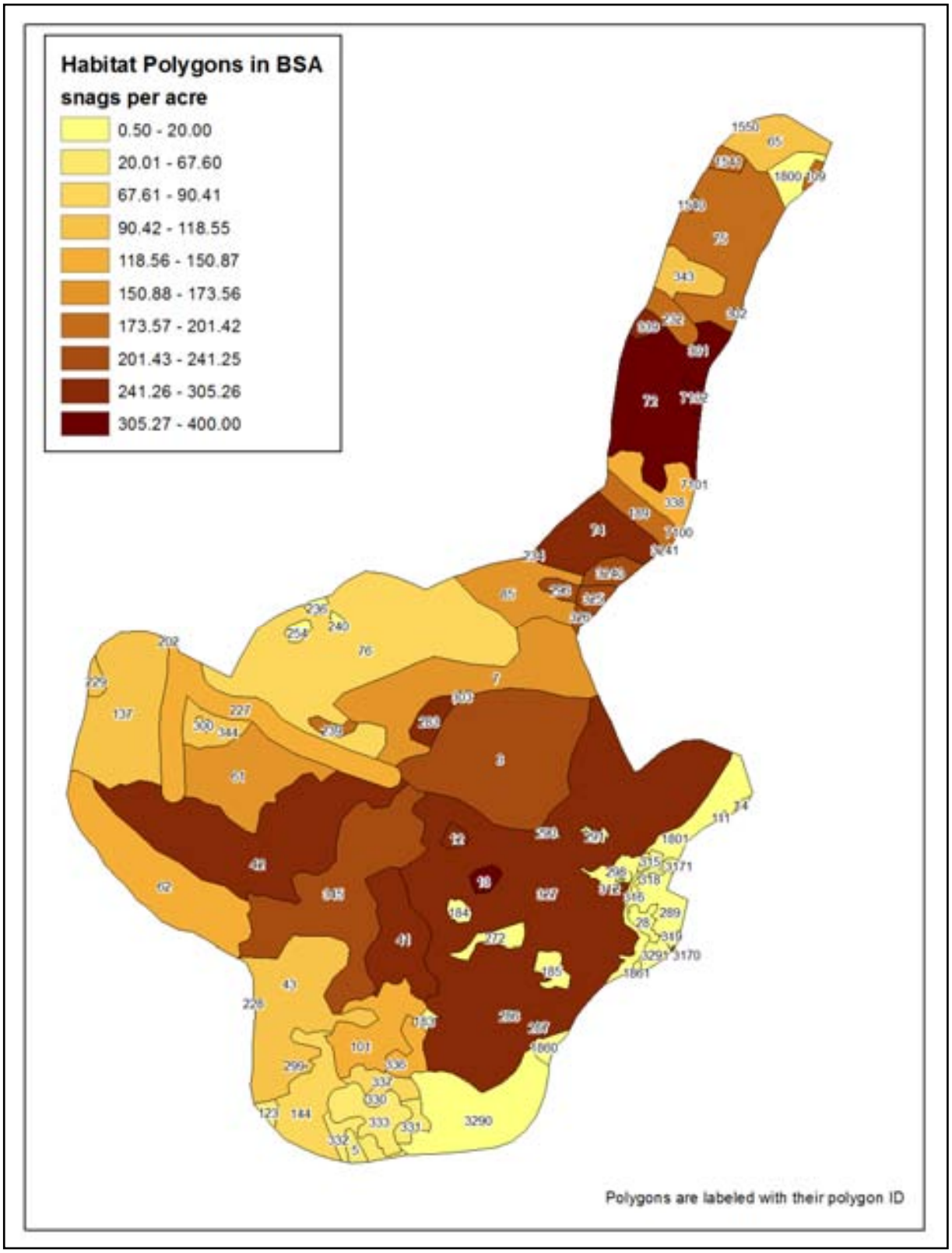

Figure 25. The density of snags in the stands of the BSA.

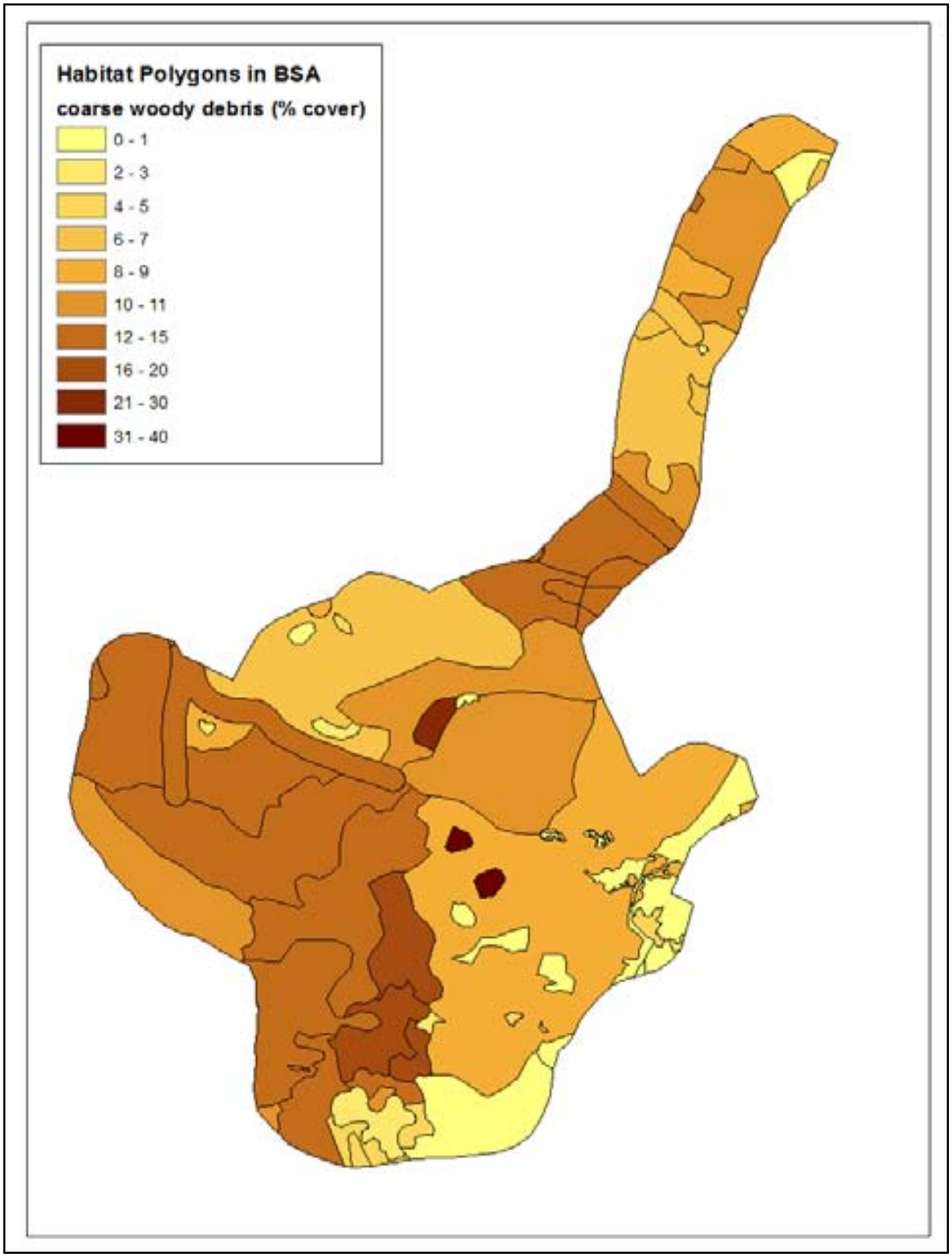

Figure 26. The percent cover of logs (coarse woody debris) in the stands of the BSA.

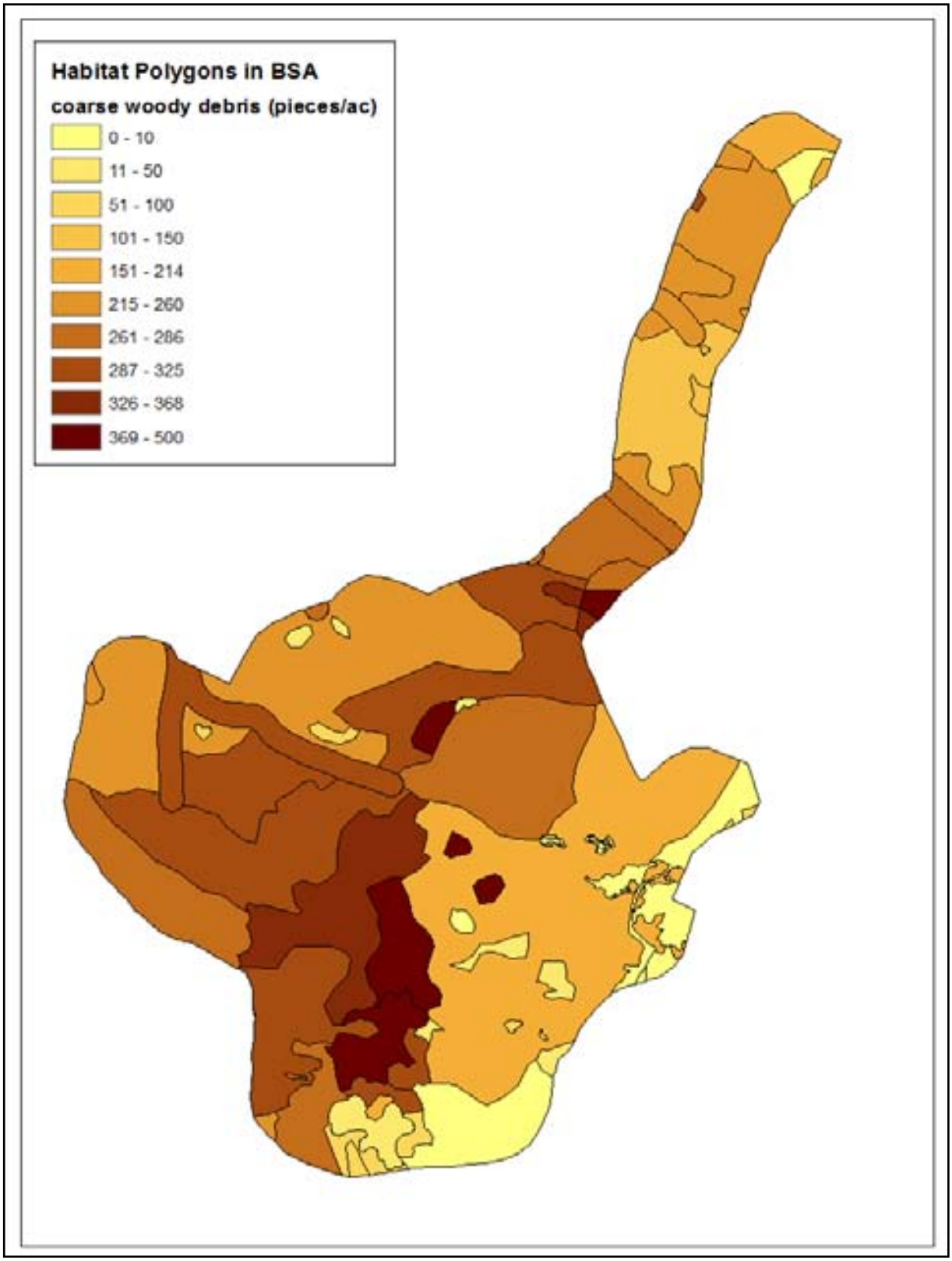

Figure 27. The number of logs per acre in the stands of the BSA.