

**Application of the
Tongass National Forest
Deer Winter Habitat Suitability Model
to the
Tongass Forest Plan Amendment
Draft Environmental Impact Statement**

Prepared by

Tetra Tech EC

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1.0 Overview

The purpose of this analysis was to (1) evaluate reductions in winter habitat capability under each alternative, as indicated by changes in DeGayner Deer Model habitat suitability index (HSI) scores, and (2) estimate the percentage of high value deer winter range that could be harvested under each alternative. Changes in winter habitat capability and harvest of high value winter range were based on projected 1954 (point at which large-scale timber harvest began) conditions. Analyses were run at the wildlife analysis area (WAA) level, as this is the land division used by the ADF&G for deer inventories and planning. A cross-walk was developed to reclassify the new Forest-wide vegetation model (the Size-Density model [SDM]) into the deer model vegetation categories (high, medium, low volume old-growth). High volume stands included SDM vegetation categories SD5N, SD5S, and SD67; medium volume stands include SD4N, SD4S, and SD5H; and low volume stands include SD4H. HSI scores from this model range from 0 to 1.3 but were standardized to range from 0 to 1.0 by dividing all values by 1.3, because outputs from such models represent a range from 0 to 100 percent habitat suitability, with higher values indicating higher habitat capability. Lands under non-federal ownership are assumed to have no habitat capability.

Documentation of consultation with Dr. Tom Hanley of the Pacific Northwest Research Station regarding the use of the DeGayner and the Hanley Deer Models is provided for reference in Appendices A and B.

2.0 Deer Model HSI Prediction

2.1 Estimating Current (2006) Winter Range Conditions

Using the 4 categorical variables (snow level, aspect, elevation, and vegetation) the model assigned a 4-letter code and corresponding numeric HSI score to every polygon in

each WAA. A weighted average of all the HSI scores within a WAA, based on polygon acreage, was calculated to obtain the WAA-level HSI score. This was done by multiplying the HSI score for each polygon by the ratio of acres in that polygon to the total acres in the WAA and summing across all the polygons in the WAA. The accompanying Excel file (HSI Scores1954-2006-Alts.xls) shows the current (2006) HSI scores for each WAA.

2.2 Estimating 1954 Winter Range Conditions

To estimate 1954 habitat suitability, it was necessary to “grow back” the vegetation in previously harvested units. Previously harvested units (HS1, HS2, and HS3 categories in the SDM GIS coverage) were assumed to have been stands of productive old-growth. The variable for volume class (VolClass) in the Existing Veg layer, which exists for most stands that have recently been harvested, was used as an indicator of their 1954 VolStratum categories. Stands with an Existing Veg VolClass of 4 or 5 were assumed to have been medium volume productive old-growth in 1954, following the assumption that few low VolStrata stands were harvest; stands with a VolClass of Null, 3, 6, or 7 were assumed to have been high VolStratum productive old-growth. VolStratum 6 and 7 were obviously in high VolStratum and it was assumed that the remainder of the stands that were harvested many years ago were in the high VolStratum also. All stands with a date of origin prior to 1954 were not modified. Once a 1954 vegetation category had been assigned, a new HSI score (weighted average of HSI scores as described above) was recalculated for each WAA. The accompanying Excel file (HSI Scores1954-2006-Alts.xls) also shows the 1954 HSI scores for each WAA.

2.3 Estimating Future Winter Range Conditions

Future habitat suitability was based on maximum timber harvest after full implementation of the Forest Plan under each alternative. It was assumed that 25 percent of the harvestable acreage would be in the stand initiation stage (I) and 75 percent of harvestable acreage would be in the stem exclusion stage (E) of stand development after full implementation. In addition, the model implementation reduction factor (MIRF), or the percent of the mapped suitable acres not actually harvested due to factors identified during implementation (e.g., karst, unstable slopes and other issues that preclude harvest during timber sale layout) are taken into account (ranging from 8 to 42 percent depending on in which area of the Forest the WAA occurs and the alternative), as they are for the timber volume estimation and the SPECTRUM ASQ modeling.

Accordingly, future WAA-level HSI scores were based on a weighted average of three scenarios, or model runs, which assumes that all harvestable lands are harvested, and is outlined below. This approach produces an unbiased estimate of future HSI scores under the assumption that 25% of all suitable forest land is in the I stage, 75% is in the E stage, the remaining harvested young growth (unsuitable) is in the E stage, and all old growth and natural young growth remains the same.

- For all 3 runs, change the vegetation code of all unsuitable young growth (SDM categories HS1, HS2, HS3) to the stem exclusion stage (E), leave all natural young growth (S1, S2, S3) the same, and leave all old growth and other vegetation the same.
- Stand Initiation (I) Scenario: run the model once changing the vegetation code of all suitable forest land to 'I'; calculate a weighted average for each WAA.
- Stem Exclusion ('E') Scenario: run the model again changing the vegetation code of all suitable forest land to E; calculate a weighted average for each WAA.
- No Harvest Scenario (to account for the portion of the mapped suitable that is MIRF and is not harvested): run the model again, changing the vegetation code of harvested young growth (SDM categories HS1, HS2, HS3) to E.
- To calculate the overall weighted average future HSI score for each WAA the following weights were applied:

Administrative Area	Model Scenario	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Chatham	No-Harvest	0.30	0.33	0.34	0.37	0.36	0.36	0.37
	I	0.17	0.17	0.16	0.16	0.16	0.16	0.16
	E	0.52	0.50	0.49	0.47	0.48	0.48	0.47
Stikine	No-Harvest	0.13	0.14	0.14	0.15	0.15	0.15	0.15
	I	0.22	0.22	0.21	0.21	0.21	0.21	0.21
	E	0.65	0.65	0.64	0.64	0.64	0.64	0.64
Ketchikan	No-Harvest	0.17	0.18	0.19	0.20	0.20	0.20	0.20
	I	0.21	0.20	0.20	0.20	0.20	0.20	0.20
	E	0.62	0.61	0.61	0.60	0.60	0.60	0.60

The No-Harvest Scenario weights account for the area represented by MIRF and which is not harvested. Then the I and E Scenario weights represent 25% and 75% of one minus the No Harvest weights, respectively. The weights are derived in the accompanying Excel file (MIRF for Deer Model-rev.xls).

2.4 Draft EIS Table Values

2.4.1 Calculating Reductions in Winter Range Habitat Capability (Table 3.10-6 in Draft EIS)

To estimate the percentage of 1954 winter range habitat capability that currently remains, and would remain under each alternative after full implementation of the Forest Plan, the 1954 HSI score was divided by the current and future HSI score for each WAA, respectively. This illustrates the cumulative effect of timber harvest on estimated deer

habitat capability, from the beginning of large-scale timber harvest on NFS lands in 1954 to the present and to the year 2105.

2.4.2 Calculating the Percent of High Quality Winter Range Harvested by Alternative (Table 3.10-7 in Draft EIS)

To take into account effects on deer across the Tongass inhabiting areas that vary naturally in their habitat quality, high quality habitat was defined as the quartile of the current land base with the highest HSI scores within each WAA. This was defined by using the following process:

- sorting HSI scores within each WAA from highest to lowest by polygon;
- filtering out all polygons with HSI scores = 0 (this area was not included when identifying the area percentages);
- identifying the polygons that are in the highest 25% based on the WAA acreage, by accumulating the acreages starting with the polygons with the highest HSI scores and working down until 25% of the area was included; and
- determining the percentage of these acres (which represent the highest quality deer winter range within each WAA) that are harvested under each alternative.

Appendix A

Consultation Regarding the DeGayner Deer Model

Science Support for the Tongass National Forest Land and Resource Management Plan Amendment

Topic: DeGayner Deer Model

Type of product: Consultation

Issue: The deer habitat model was developed by an expert panel during the construction of the 1997 Forest plan. It was subsequently modified by Eugene DeGayner for use at the landscape scale to determine deer carrying capacity in different forest conditions. The Forest is concerned that the existing model does not provide project-specific information useful in project planning.

Science Question: What is the appropriate use of the existing DeGayner deer model?

Suggested Science Contributor: Thomas A. Hanley

Response:

BACKGROUND

The deer model developed during the 1997 Forest Plan was intended to provide a quantitative estimate of habitat value for black-tailed deer in Southeast Alaska. It is based on expert opinion because there were no data-based models driven by explicit, quantitative, biological/ecological equations available at that time. The habitat types (categories) were very broad and general, and they were not based on any particular site-specific data. The model generated numbers of deer (per unit area), but the numbers were really only of relative value, not absolute value. They reflected the experts' judgment of the relative differences in habitat value across such broad categories as forest type, topographic situation, and season (e.g., medium to high volume old growth, low volume old growth, even-aged young growth, recent clearcut; low elevation, mid elevation, high elevation; north-facing slope, south-facing-slope; summer, winter with mild snow, winter with deep snow; etc.). Given the large differences in deer habitat value between many of these broad classes of habitat, the model provided a useful and reasonable estimate of deer habitat value for large-scale analyses (e.g., so many thousands of acres of this or that habitat, compared with so many thousands of acres of some other distribution of habitat). As such, it was appropriate for the Tongass-wide analyses of the 1997 TLMP.

Subsequent modifications to that initial model have attempted to use it for site-specific applications or other uses (e.g., for estimating prey availability for wolves). Each of

those modifications is tenuous, as the more specific the hypothetical model becomes, the more assumptions it needs, and the more likely it is to suffer from unfounded (incorrect?), judgment-based assumptions. However, if the site-specific applications or other uses are necessary in the land management process, then there is no way avoiding them. In that case, it is most important that the new assumptions be clearly identified and a rationale provided for them. Then, if other users differ in their opinions about the additional assumptions, the differences in opinions can be clearly focused on the specific assumptions in question. The bottom line is that the model, in any case, provides a *relative* estimate of habitat value for deer (one or more habitats relative to others). Even if the output is treated as an absolute value in subsequent calculations (e.g., regarding hunter demand or prey availability), it would be a mistake to focus specifically on the absolute value. A sound basis for estimating *actual* deer numbers or carrying capacities of habitat in Southeast Alaska does not exist.

Scientific research published after the 1997 TLMP (cited at end of this report) adds additional knowledge to deer-habitat relations in Southeast Alaska, but does not contain anything that would change the 1997 expert-based model significantly. A new analytical system for deer habitat evaluation has been developed very recently (see TLMP Plan Amendment Item 6), and that system provides the basis for completely re-evaluating the current TLMP model, but it is an entirely data-driven system, and its data requirements cannot be met with existing Forest data. It will require several years (3?) of fieldwork before relationships can be established allowing for existing inventory databases to be used for habitat analyses in the new deer-habitat relations model.

SCIENCE QUESTION

The DeGayner deer model is most appropriate for large scale, general analyses. It is an *imprecise* model in any case, and its probable *accuracy* decreases as its scale of application decreases. It can be used for site-specific, project-level analyses (better than nothing at all), but users must recognize that its value is only at the “ballpark” level of quantification (i.e., for broad, relative comparisons of alternatives, at best). Confidence intervals cannot be calculated from this model, but if they could be calculated, they would be extremely wide for project-level planning. For example, differences between old growth and closed-canopy, young-growth forest are virtually always substantial and can be reasonably accounted for in an analysis with the DeGayner model. However, variation within old-growth forest itself can be enormous and can swamp differences attributable to topographic situations at the project-level scale of application. Similarly, site-specific details about disturbance history (for example) could result in very different values of young-growth forest than would be projected with the general model. For project-level analyses, the new habitat evaluation system (Item 6) would be the better tool, as it could be driven by site-specific data. However, such site-specific data are not currently sufficient for routine, practical application.

Thomas A. Hanley
PNW Research Station – Juneau
22 June 2006

Important publications concerning deer in Southeast Alaska, since 1997:

- Parker, K.L., M.P. Gillingham, T.A. Hanley, and C.T. Robbins. 1999. Energy and protein balance of free-ranging black-tailed deer in a natural forest environment. *Wildlife Monographs* 143:1-48.
- Person, D.K. 2001. Alexander Archipelago wolves: ecology and population viability in a disturbed, insular landscape. Ph.D. thesis. Univ. Alaska, Fairbanks.
- Doerr, J.G., E.J. DeGayner, and G. Ith. 2005. Winter habitat selection by Sitka black-tailed deer. *Journal of Wildlife Management* 69:322-331.
- Farmer, C.J., D.K. Person, and R.T. Boyer. 2006. Risk factors and mortality of black-tailed deer in a managed forest landscape. *Journal of Wildlife Management* (*in press*)

Appendix B

Consultation Regarding the Hanley Deer Model

Science Support for the Tongass National Forest Land and Resource Management Plan Amendment

Topic: Hanley Deer Model

Type of product: Consultation

Issue: The Hanley deer model was developed by Dr. Hanley to address project level information needs. The Forest is concerned about the appropriate use of the model for project-specific planning level work.

Science Question: What is the appropriate use of the Hanley deer model for project level use?

Suggested Science Contributor: Thomas A. Hanley

Response:

BACKGROUND

The Forage Resource Evaluation System for Habitat (FRESH-Deer Model) is a quantitative tool for evaluating habitat quality for black-tailed deer in Southeast Alaska. It is an entirely food-based system, relating the quantity (biomass per unit area) and quality (digestible energy and digestible protein) of available forage to known metabolic requirements of deer, yielding a calculation of the number of deer days (one deer for one day) that can be supported at the specified level of metabolic requirement (varies with age, sex, reproductive status, and season). FRESH-Deer is a collaborative effort between Thomas Hanley (PNW Research Station), Donald E. Spalinger and Kenrick J. Mock (both professors at University of Alaska Anchorage -- UAA), and Grant M. Harris (Chugach National Forest). The programming was completed in late 2005, and the system is now accessible to the general public through a UAA website (<http://cervid.uaa.alaska.edu/>). The system consists of a web-based application for analyses at the stand-level of spatial scale and a GIS-based application (downloadable from the website) for analysis at the landscape-level scale (e.g., watershed, multi-stand project level). It provides a “snapshot” analysis of habitat capability at one specified point of time. Analyses are usually conducted for adult female deer in mid July at two levels of metabolic requirements – maintenance only, and maintenance plus lactation – and in February, for summer and winter comparisons, respectively. The system includes a snow submodel for winter analyses. Although the calculations yield deer days (the actual number of deer that could be supported at the specified level of metabolic requirements), the deer days value does not include considerations of plant-herbivore feedbacks, so should not be considered a true ecological “carrying capacity” value. Also, food resources and metabolic requirements change continuously throughout the year, so

the “snapshot” analysis is best considered as a relative index (for comparisons of habitats or landscapes) rather than an absolute value itself. Because it is entirely data-based and driven by known quantitative nutritional relations (equations), it provides an entirely transparent and objective means of evaluating and comparing habitats. The system is currently operable and has been used several times in research applications.

The FRESH-Deer system was designed for project-level applications, and its data requirements are intensive, in comparison to those of the “DeGayner deer model” (TLMP Plan Amendment Item 5). For its most precise application, field data for forage biomass and nutritional quality (by plant species and plant part) would be obtained at the stand level within the project area – for both stand-level and landscape-level applications. Data requirements in such cases, however, are enormous and impractical for routine application. Alternatively, users can bypass the need for collecting original data if they can classify and map their habitats in relation to habitats already described in databases linked to the FRESH-Deer system. The FRESH-Deer system includes linked databases of all descriptions of forest understory biomass and nutritional values known for Southeast Alaska. Currently, however, both the biomass and the nutritional databases are preliminary and not sufficient for general use. More extensive databases are needed for practical, routine application in forest management.

APPLICATION NEEDS

There are two broad areas of additional work needed before the FRESH-Deer system is ready for routine application in forest management: (1) database development and field verification of the model; and (2) incorporation of deer behavior into the analytical system.

Much fieldwork is necessary to develop adequate databases for both forage biomass and nutritional quality. The Tongass NF already has extensive inventory databases for understory plant communities based on huge amounts of fieldwork (e.g., the “plant association” classification system). However, all those data are in terms of plant canopy coverage, while the FRESH-Deer system requires biomass data. With a reasonable amount of focused fieldwork (3 summers?), quantitative relations can be developed for converting the current plant association descriptions from canopy cover to biomass. Similarly, the Tongass-wide nutritional database could be expanded significantly with nutritional analyses of a subsample of plants collected during the biomass fieldwork. Within a few years, both databases could be made adequate for routine use in forest management. During that time, fieldwork is also needed for verifying the current snow submodel and gaining more experience with results from the FRESH system – identifying weaknesses or errors and opportunities for improvement. The system currently is, in effect, “right out of the box;” it needs some “road testing.”

The FRESH system is based on food resources and does not include considerations of other factors affecting habitat quality for deer (e.g., factors related to predation, hunting vulnerability, hiding/escape cover, etc.). Effects of those other factors are manifested in patterns of deer behavior and can result in some otherwise excellent patches of food going relatively unutilized because deer do not want to go there. One way of incorporating deer behavior into the FRESH system is through the use of “resource utilization functions,” which are empirical descriptions (similar to multiple regression equations) of patterns of deer habitat use, usually derived from habitat

use/availability studies such as with radio telemetry. Such studies and derived utilization functions are most valid as *descriptors* of observed patterns of use, not as *predictors* of future patterns of use, because the results of each study are so specific to its time, place, and even the deer population density. In other words, results often differ significantly between study areas and even between years (especially winters) within the same study area. However, David Person (Alaska Dept. Fish & Game, Ketchikan) is currently conducting a meta-analysis of 5 major studies of habitat use conducted throughout the range of Southeast Alaska over the past 25 years or so. Results from that meta-analysis (consistent patterns across all studies, areas, years) are much more likely to have predictive value for any new area than would be the case for any one of the studies alone. Person expects to complete his analysis within the forthcoming year. It is anticipated that the resource utilization functions derived by Person will be incorporated into the FRESH-Deer system (GIS landscape-level application) as an option for users by considering the resource utilization function values as probabilities of use. In other words, each cell in a GIS system will have both a food-derived value (FRESH system) and a probability-of-use value (from the resource utilization functions); multiplying the two together will yield a behavior-adjusted estimate of the food resources in that cell. The user then could analyze habitat (landscape scale) on the basis of food alone, deer behavior alone, and/or the combination of both. Similarities and, especially, differences should be insightful. Although the resource utilization functions are not derived from known cause-and-effect relations (they are strictly empirical descriptions), their values will be entirely data-driven (i.e., no “expert opinion”).

A note about large-scale application: The fully developed FRESH-Deer system will not be directly applicable to extremely large-scale (e.g., Tongass-wide) applications, because the data entry and computational requirements would be extreme (e.g., each habitat patch on the entire Tongass NF). However, the Fresh-Deer system and behavior-adjusted option can be used to examine the current TLMP deer model and/or to derive a new model for very large-scale analyses. The advantage of using the FRESH-Deer system, rather than an expert opinion system, is that all relations would be entirely transparent and data driven. There would be no “black box” relations derived from expert opinion. The FRESH-Deer system could be used to calculate values for the broad, general categories needed for Forest-wide analyses after specifying the assumed average conditions of each category.

SCIENCE QUESTION

My answer to this item’s “science question” (What is the appropriate use of the Hanley deer model for project level use?) is as follows:

The FRESH-Deer system was designed for the project-level scale of application, and it already is suitable and available for use. However, currently its linked biomass and nutritional databases are too meager for general use – any user would need to collect their own field data for analysis, and that is impractical for routine application. Also, the FRESH-Deer system is brand new, and some parts (e.g., the snow submodel) need field verification, while the entire system needs “road testing.” Thus, it is currently too soon for practical application of the FRESH-Deer system in routine Tongass management/planning.

However, with a modicum of concerted field and laboratory effort over a few field seasons (3 years?), the Tongass NF could develop the necessary relations for converting their already extensive inventory databases from canopy coverage to reasonable estimates of biomass, and they could expand the nutritional database to a generally useful, Tongass-wide database suitable for routine project-level analyses. The additional incorporation of the Person behavior-based resource utilization functions would extend the analytical capabilities beyond food alone and likely would result in much wider acceptance of the habitat evaluations by other agencies/critics. The FRESH-Deer system also could provide a transparent basis for evaluating and/or replacing the current expert-opinion based, large scale TLMP model.

Thomas A. Hanley
PNW Research Station – Juneau
22 June 2006