# FISH AND WILDLIFE HABITAT CAPABILITY MODELS
# AND
# SPECIAL HABITAT CRITERIA

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Under National Forest Management Act (NFMA) planning regulations (36 CFR 219), fish and wildlife management indicator species are selected by each National Forest for planning and management attention. Information on these species will help guide land allocations and shape multiple-resource prescriptions to meet legal requirements and local resource demand. There must be a documented description of the habitat conditions needed to sustain each species at different population levels. The minimum habitat conditions necessary for sustaining population viability also must be documented.

The development of prescriptions to favor certain management indicator species also requires a description of habitat conditions associated with high population levels of each species. The descriptions of habitat conditions associated with different population levels are called Habitat Capability Models (HCM).

NFMA regulations mandate that each National Forest maintain habitat conditions to support wildlife and fish populations at or above the abundance and distribution needed for long-term population viability. However, neither managers nor scientists fully know what kinds, amounts, and distributions of habitats are necessary to maintain population viability. Existing knowledge of species ecology and habitat needs must serve to describe the habitat conditions needed. Models (standards and criteria) must be formulated to describe in quantitative and qualitative terms the habitat conditions by which to judge existing and projected habitats.

Most HCMs address the habitat conditions required by individual reproductive units within wildlife and fish populations. This is because land management projects usually affect a small part of populations such as a breeding pair, a family unit, a small group of breeding pairs, or a small group of family units before whole population changes are noticed. Total population and distribution in a geographic area can be projected by aggregating and mapping those land areas that provide suitable habitat for reproductive units of populations.

The HCMs do not address some aspects of population viability. Distances between reproductive units and population size are two important attributes of viability that must be addressed outside the HCMs. An example of an HCM is shown in Table 1. The table, which is quite long, is followed by an explanation of the items included in the table.

Table 1. CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS SYSTEM:

HABITAT CAPABILITY MODEL FOR THE PEREGRINE FALCON (Shimamoto and Airola 1981)

Peregrine Falcon — *Falco peregrinus*

Family: Falconidae Order: Falconiformes Class: Aves

Management Status: Endangered Date: 1/15/82

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MODEL APPLICABILITY:

Life Stage(s): All

Season(s): All

Geographic Area: Northern California

Intended Application: National Forest Land and Resource Management Planning, forest management projects

Expected Reliability: Level 4 - Model structures and outputs appear reasonable to species authorities

Verification Status: Model reviewed by species authorities

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Table 1 (Continued)

| HABITAT VARIABLE | HABITAT CAPABILITY (Suitable*) HIGH (Preferred) | (Suitable*) MEDIUM (Required**) | (Unsuitable*) LOW (Marginal) |
|---|---|---|---|
| Elevation (2, 11) | <4000' | 4000-8000' | >8000' |
| Cliff Conditions (2, 3, 10, 11) | Vertical faces 75-300 feet high with abundant ledges at least 10 sq. ft. or large deep cliff-face caves, providing a commanding view | | |
| Cliff Aspect at Elevations >4000' (2, 3) | 135°-225° (SE-SW) | 45°-135° (NE-SE) 225°-315° (SW-NW) | 315°-45° (NW-NE) |
| | (Note: At lower elevations all aspects are used) | | |
| Food Supply (2, 3, 11, 13) | Abundant and available avian prey within 6 miles of nest site. Common prey species are band-tailed pigeon, rock dove, mourning dove, common flicker, jays, starlings, robin, western meadowlark, acorn woodpeckers, red-winged blackbird, cedar waxwing (listed in order of importance). | | |
| Proximity to a major river, lake, or marsh (1,2,3) | <1/2 mile | 1/2-1 mile | >1 mile |
| Disturbance (1, 2, 3, 4, 11) | No disturbance within 2 miles of the nest site, March 1 to May 15 | Short term disturbance within 1 mile of the nest site, March 1 to May 15 | Moderate to high disturbance within 1 mile of the nest site |

* Suitability refers to the appropriateness of applying habitat management practices to improve capability, or of placing management emphasis on the stated habitat conditions.

** These values or higher are required for long-term viability.

Table 1 (Continued)

LITERATURE AND OTHER REFERENCES CITED IN TABLE 1

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End of table

EXPLANATION OF TABLE 1.

Model Applicability

Life Stage(s) - Identify the appropriate life stages covered by the model e.g. egg, larval, fry, juvenile, adult, all

Season(s) - Identify the appropriate season(s) e.g. fall, winter, spring, summer

Geographic Area - The model may apply to the species' entire range. However, if regional differences in habitat use and preference occur, separate models may be appropriate.

Intended Application - Most models will be formulated with Forest planning in mind. Some models, however, may be detailed enough to apply to project work. Provide a clear statement of the intended use.

Expected Reliability - The following hierarchy was used:

Level 1 - Model predicts existing carrying capacity density with acceptable variance, i.e. 10-20%

Level 2 - Model habitat capability ratings directly correlate with density estimates

Level 3 - Model habitat capability ratings directly correlate with ratings of the same sites by species authorities

Level 4 - Model structure and outputs appear reasonable to species authorities

Level 5 - Model structure and outputs meet technical standards and appear reasonable to author(s), editor(s), and users

Verification Status - The purpose of verification is to ensure that the model meets the expected reliability criteria and that it faithfully provides the intended outputs. Each step in verification depends on the expected reliability of the model. The following hierarchy was used:

1) Model is in draft.

2) Model reviewed by editor (the editor should check for conformance with model quality standards, sufficiency of documentation, and understandability).

3) Model reviewed by editor and users.

4) Model reviewed by species authority.

5) Model evaluated with sample data - apply the model with sample data sets which mimic various habitat conditions, e.g. high, medium, and low habitat capability. Evaluate model outputs as to how well they give a reasonable prediction of habitat conditions.

6) Model tested with field data - field data must be available to provide measurements of both habitat variables and indicators of habitat capability. The latter can range from ratings of habitat capability by species authorities to density estimates to actual densities. Statistical and sampling expertise is required to design and perform these tests.

Habitat Capability

Model variables were restricted to physical, chemical, or biological characteristics of habitats. Species population variables, such as birth rates and sex ratios, are not suitable due to high cost of measurement, difficulty of prediction, and dependency on other factors beyond habitat. The critical question answered was, "what environmental variable, when changed, will affect the capability of an area to support a management indicator species?"

Each of the identified habitat variables were combined with the others to produce a habitat capability model. Each variable has values with different implications for habitat capability. Each of the variables and its respective values were ranked according to habitat capability:

High: the values are related to the highest densities of the species; the values are preferred over other values;

Medium: the values are related to moderate densities of the species; the values are

required for the long-term viability of the population or reproductive unit of the population;

Low: the values are related to the lowest densities of the species; the values denote marginal habitat capability for the species and would not be capable of supporting a viable population.

The variables were organized according to their importance in determining habitat capability and arrayed in rows under the headings high, medium, and low. An attempt was made to reduce redundant variables, retaining only those variables that are most practical to measure.

Documentation

As in model reliability and verification status, documentation for each model is in varying stages of completion. The levels of documentation are:

Level 1 - Literature references, written or personal communication, and the author's judgment are cited.

Level 2 - A narrative accompanies the model, summarizing why each variable was selected, how each variable is related to the species' habitat needs, and how habitat capability values were determined. This level also includes Level 1.

Level 3 - A narrative accompanies the model with documentation on the species ecology and habitat use. This information is related to the habitat variables in the model. It involves preparing a species note with the following information:

I. Distribution, Abundance, and Seasonality

II. Specific Habitat Requirements

A. Feeding

B. Cover

C. Water

D. Reproduction

E. Pattern

III. Species Life History

A. Activity Patterns

B. Seasonal Movements/Migration

C. Home Range/Territory

D. Reproduction

E. Niche

This level also includes Levels 1 and 2.

Level 4 - The habitat variables are aggregated to develop a mathematical formulation of the model (U.S. Fish and Wildlife Service 1980). Assumptions and limitations to be used when applying the model are provided and the necessary steps to correctly use the mathematical model is documented. The latter includes how to collect data on model variables, how to treat that data as model inputs, and how to interpret habitat capability based on the data. This level includes levels 1, 2, and 3.

Because many initial species models will be developed from scant data, modelers will rely on experiential evidence and intuition to establish the model variables and relationships. Such models will have level 1 or 2 documentation. As model application and verification improve, habitat relationships can be more accurately represented and the models made more quantitative. Models with level 3 or documentation are examples of species where more information is known and the models have been "calibrated" with real data.

## Vegetation Types and Successional Stages

The vegetation types and successional stages used in the habitat capability models are consistent with the California Wildlife Habitat Relationships Program for the Northeast Interior Zone (Laudenslayer 1982), the Western Sierra Zone (Verner and Boss 1980) and the North Coast-Cascades Zone (Marcot 1979). For convenience, the codes used for successional stages are defined in Table 2.

Table 2. Successional stage codes

| Code | Definition |
|---|---|
| 1 | Barren/grass/forbs |
| 2 | Shrub/seedling/sapling; tree saplings 11" DBH |
| 2a | <40% tree canopy closure |
| 2b | 40-70% tree canopy closure |
| 2c | >70% tree canopy closure |
| 3 | Small sawtimber; 11-24" DBH |
| 3a | <40% overstory canopy closure |
| 3b | 40-70% overstory canopy closure |
| 3c | >70% overstory canopy closure |
| 4 | Medium to large sawtimber; 24" DBH |
| 4a | <40% overstory canopy closure |
| 4b | 40-70% overstory canopy closure |
| 4c | >70% overstory canopy closure |
| 5 | Two-storied stand; scattered overstory over a well-stocked understory (4a over 2c or 3c) |

## Rating Overall Habitat Capability

For any given area of land, habitat capability ratings (high, medium, low) will be different for each habitat variable. This makes rating the overall habitat capability difficult. Models for spotted owl, marten, and mule deer have been developed to include a mathematical calculation of habitat capability where different ratings are quantitatively assessed and an overall capability index is mathematically calculated. The method for rating overall habitat capability for the other models, however, must be done using subjective biological judgment. For such cases, the simplest approach is to assess the overall habitat capability rating in terms of a simple majority of variable ratings. For example, if three variables were rated as medium and one variable as high for bald eagle habitat, the overall rating could be considered medium. In other situations, experience may justify identifying one or more variables as more important or possibly overriding other variables. Biologists should then weigh these variables accordingly when determining overall habitat capability.

## SPECIAL HABITAT CRITERIA MODELS

As an extension of the HCM concept, Special Habitat Criteria were developed by biologists on the Stanislaus National Forest (Hurley et al. 1981). While HCMs describe habitat conditions for individual management indicator species, the information in the Special Habitat Criteria models describes conditions necessary to maintain or optimize populations of fish and wildlife species closely associated with special habitats (riparian, aspen, snags, etc.). An example is shown in Table 3.

and wildlife species closely associated with special habitats (riparian, aspen, snags, etc.). An example is shown in Table 3.

Table 3. Excerpts from special habitat criteria for mountain meadows. Adapted from Hurley et al. (1981).

AREA: Western Sierra Nevada

| HABITAT VARIABLE | HABITAT CRITERIA HIGH (Preferred) | MEDIUM (Required**) | LOW (Marginal) |
|---|---|---|---|
| FOREST/MEADOW EDGE(1) | | | |
| Width of timbered edge | >200 ft | 100-200 ft | <100 ft |
| Amount of edge in trees ≥24" dbh | >80% | 60-80% | 40-60% |
| Crown cover in timbered edge | 40-70% | >70% | <40% |
| VEGETATION & SOIL(2) CONDITIONS IN MEADOW | Willows vigorous<br>Sedges, rushes, grasses dominant<br>Water table high<br><15% bare ground | | Willows decadent;<br>Invasive forbs dominant;<br>Water table lowered;<br>>15% bare ground |

(1) Hurley, J.F., and A.M. Palmer, Wildlife Biologists, Stanislaus National Forest, Sonora, California. Professional judgment and analysis of forest/meadow management strategies for the Stanislaus National Forest Land Management Plan.

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** These values or higher are required for the long-term viability of meadow dependent species.

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