1. Introduction

1.1 Purpose. The purpose of this manual part is to provide guidance and standards for the development of models or the adaptation of existing models to be used in determining Habitat Suitability Indices (HSI's) for use with the Habitat Evaluation Procedures (HEP) (102 ESM).

1.2 Scope. 103 ESM provides standards for the development of models to determine HSI values for terrestrial and inland aquatic evaluation species. These standards provide general guidance for the construction of HSI models and detailed descriptions of several modeling techniques appropriate for the level of effort and resolution required in a typical Federal water resource planning effort. An HSI model may be in graphical, word, or mathematical format and must clearly document the rules and assumptions used to calculate an HSI. Documentation throughout the development and use of a model helps to establish model credibility, optimize decisionmaking capabilities, and provides a permanent record of the basis for a decision. Studies by Ellis et al. (1979) confirmed that the use of documentation increases the repeatability of determining HSI values.

HSI models can be constructed from basic life history information or by modifying existing habitat models. It is recommended that this entire document be read at least once before proceeding with actual model construction. If an existing model is to be used, the reader should focus on 103 ESM 2, 3.2, 3.4, and 3.5. If a new model is to be constructed, the reader should focus on 103 ESM 3.

1.3 Objective. The objective of this manual part is to improve the reliability of HEP applications by providing guidance for the systematic development of HSI models.

1.4 Definitions. Habitat assessments using HEP are based upon Habitat Units (HU's) which are computed by the formula:

$$\text{Habitat Units} = (\text{HSI}) \times (\text{Area of available habitat}) \quad (1)$$

The area of available habitat is defined in 102 ESM 4.1 as the total area of all cover types used by the evaluation species.

The HSI is defined as a numerical index that represents the capacity of a given habitat to support a selected fish or wildlife species. An index, as defined by Inhaber (1976), is the ratio of a value of interest divided by a standard of comparison. For HEP purposes, the value of interest is an estimate or measure of habitat conditions in the study area, and the standard of comparison is the optimum habitat conditions for the same evaluation species. Therefore,

$$\text{Index Value} = \frac{\text{Value of Interest}}{\text{Standard of Comparison}}, \text{ or} \quad (2)$$

$$\text{HSI} = \frac{\text{Study Area Habitat Conditions}}{\text{Optimum Habitat Conditions}}$$

The HSI has a minimum value of 0.0 which represents totally unsuitable habitat and a maximum value of 1.0 which represents optimum habitat. An HSI model produces a 0-1.0 index with the assumption that there is a direct linear relationship between the HSI value and carrying capacity. Specifically, the use of HEP assumes that, for any evaluation species, a unit change in HSI will always have the same significance (i.e., will always correspond to the same change of carrying capacity units). This relationship is depicted in Figure 1-1 where an increase of 0.2 HSI units corresponds to an increase of "X" units of carrying capacity.

The assumption of linearity is not as restrictive as it may first appear because any known relationship between HSI and carrying capacity can be mathematically converted to a linear relationship. When the actual relationship between HSI and carrying capacity for a particular evaluation speices is not known, it must be assumed to be linear if the model is to be used with HEP.

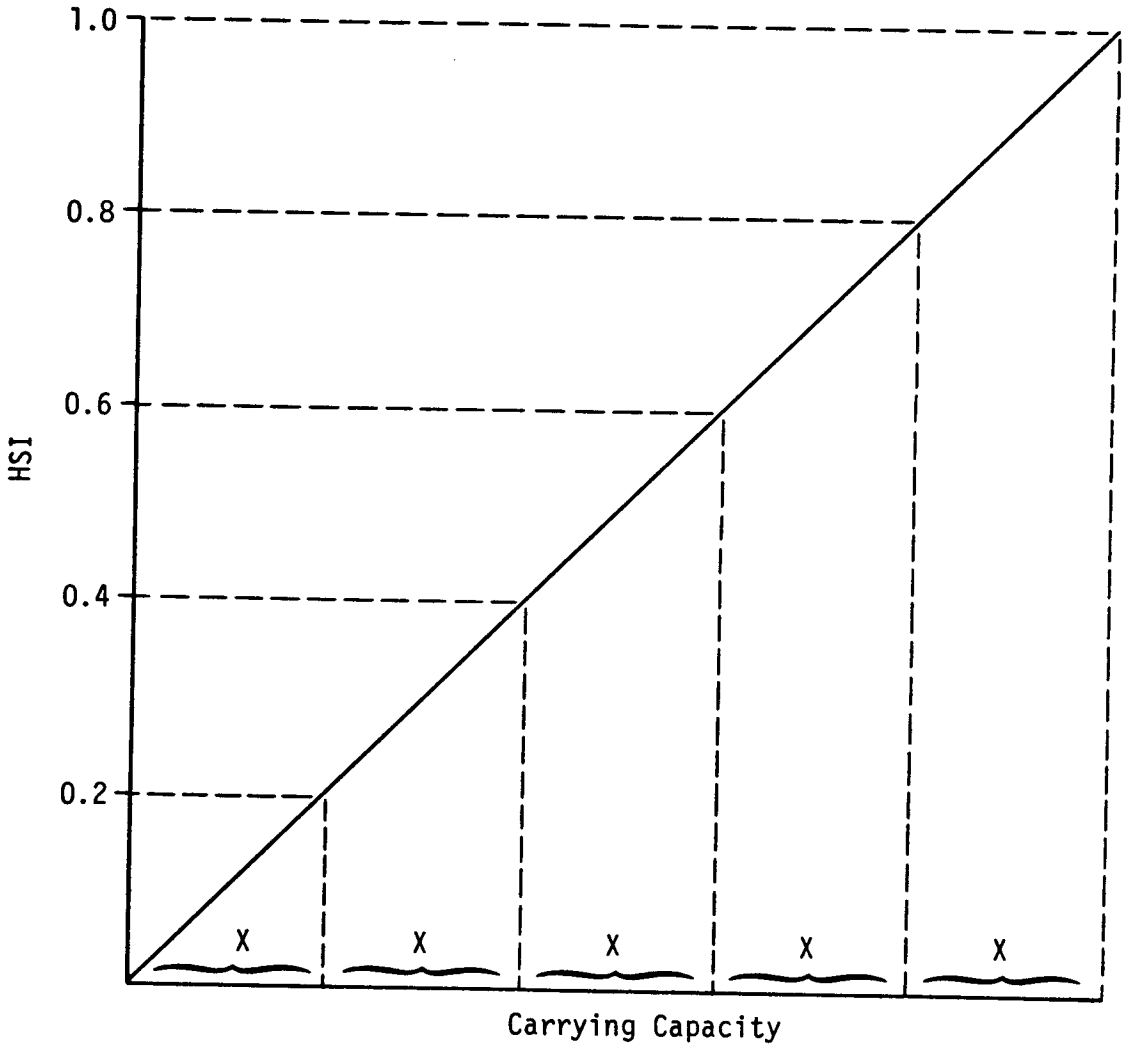

Figure 1-1. Linear relationship between HSI and carrying capacity.