5. Habitat Assessments Using Habitat Units

Habitat assessments involve measurement and description of habitat conditions for baseline (present) assessments and impact (future with and without action) assessments. For baseline assessments, different areas can be compared in terms of HU's as a guide to further land use planning. Baseline assessments are point-in-time comparisons. For impact assessments, alternative future land use actions can be compared based on predicted future availability of HU's. The net impact of a proposed land use action is the difference in predicted HU's between the future with the action and the future without the action.

5.1 Habitat Unit analysis for one point in time - Baseline assessments. Baseline assessments are used to describe existing ecological conditions. The results of baseline assessments provide a reference point from which resource planners can: 1) compare existing conditions in two or more areas in order to define management capabilities or as a guide to future land use planning; 2) predict and compare changes that may occur without the proposed action, with the proposed action, or with compensation measures; and 3) design monitoring studies. Baseline assessments play a critical role in wildlife planning by identifying wildlife resource capabilities at one point in time so that proposed future actions can be directed toward or away from specific areas. A baseline assessment involves: 1) definition of the study limits, including definition of the study area, delineation of cover types, and selection of evaluation species (Chapter 3); and 2) characterization of the study area in terms of HU's (Chapter 4).

The objective in performing a baseline assessment is to calculate the number of HU's at one point in time for each evaluation species. The area of available habitat (Section 4.1) is multiplied by the mean HSI (Section 4.2) for each evaluation species to determine the total HU's for that species in the study area. The baseline HU's are evaluated and compared directly if the baseline assessment is designed to compare existing conditions in two or more areas. Additional calculations are required (Section 5.2) if the baseline data are to be used as a reference point for impact assessments.

5.2 Habitat Unit analysis for multiple points in time - Impact assessments. Impact assessments are performed by quantifying habitat conditions at several points in time throughout some defined period of analysis. Points in time (target years) can be selected at fixed intervals such as every year, or according to some other schedule.

The assessment of land use impacts is facilitated by dividing the study area into impact segments. An impact segment is defined as an area in which the nature and intensity of the future land use can be considered homogeneous, such as the flood pool area in a reservoir project, a recreational area, or the area of a particular agricultural practice. The advantage of dividing the study area into impact segments is that only one condition need be considered for each cover type within each impact segment. The effects of a

particular action may be analyzed over a large area by assuming that the same condition exists throughout each impact-segment-cover-type zone.

Habitat Units must be calculated for the evaluation species at each of the future points in time for future-with and future-without project conditions; this process includes predicting total available habitat and HSI for each evaluation species, using the same HSI models that were used for the baseline year.

A. Use of target years for future predictions. The impact assessment can be simplified by selecting target years (TY's) for which habitat conditions can be reasonably defined. At a minimum, target years should be selected for points in time when the rates of loss or gain in HSI or area are predicted to change. Rates of loss or gain in HSI or area are assumed to occur linearly between target years.

There are several requirements for the selection of target years. The HU-time analysis must begin at a baseline year (TY-0). A baseline year is defined as a point in time before proposed changes in land and water use result in habitat alterations in the study area. In most cases, the baseline year will be existing or current year conditions. However, in some cases, current habitat conditions may reflect proposed action influences. For example, landowners or managers may begin clearing bottomland timber from flood prone sites located downstream from an anticipated flood control project before baseline studies can be initiated. In such cases, baseline year conditions will be those that existed in some previous year. Judgment is required in defining baseline year habitat conditions when present conditions reflect proposed action influences.

In addition to a baseline year, there must always be a target year 1 and an ending target year which defines the future period of analysis. Target year 1 is the first year land and water use conditions are expected to deviate from baseline conditions. The habitat conditions (HSI and area) described for each target year are the expected conditions at the end of that year.

B. Predicting future area of available habitat. For each proposed action, the area of available habitat must be estimated for future years. Some cover types will increase in total area, others will decrease, and in some cases new cover types will be created or existing ones totally lost under projected future conditions.

The user must constantly check to ascertain that the total area of the study does not vary from the baseline area. The recommended method for determining the future area of cover types is the use of cover type maps. The method of developing a cover type map for a future year is to overlay impact segment boundaries on the baseline cover map previously developed (Section 3.2). Baseline cover types will either be unaltered, altered (i.e., variables such as % vegetation cover may change), or converted to new cover types depending on such factors as land use within the impact segment, vegetation successional trends, and management. Areas converted to new cover types through succession or impacts are given a new cover type designation. Altered cover types are designated a subtype (e.g., deciduous forest altered by flooding). An overlay of impact segment boundaries may be required for each target year. Each proposed action requires its own series of overlays in order to determine changes in area of available habitat between selected target years. Figure 5-1 illustrates how a baseline cover type map could be used in conjunction with impact segments to produce cover type maps for future conditions.

C. Predicting future HSI. The same models that were used to determine baseline HSI values must be used to determine future HSI values. If, for example, a mathematical model was used to calculate baseline HSI, a related word model cannot be used to predict future HSI values, or vice versa.

Estimating HSI values for future years requires predictions of changes in the physical, vegetative, and chemical variables of each cover type. Impact segment overlays can be used as an aid in estimating these variables. For example, seasonal flooding could alter a forest understory but not the canopy closure. Changes in interspersion relationships due to creation of new cover types or conversion of existing cover types also can affect HSI model output and can be easily measured on future cover type maps (impact segment overlays).

D. Annualization of impacts. Most Federal agencies use annualization as a means to display benefits and costs, and the habitat analysis should provide data that can be directly compared to the benefit/cost analysis. The annualization process will be described in detail, although it is not the only mechanism with which to display future habitat changes. Federal projects are evaluated over a period of time that is referred to as the "life of the project" and is defined as that period between the time that the project becomes operational and the end of the project life as determined by the construction, or lead, agency. However, in many cases gains or losses in wildlife habitat may occur before the project becomes operational, and these changes should be considered in

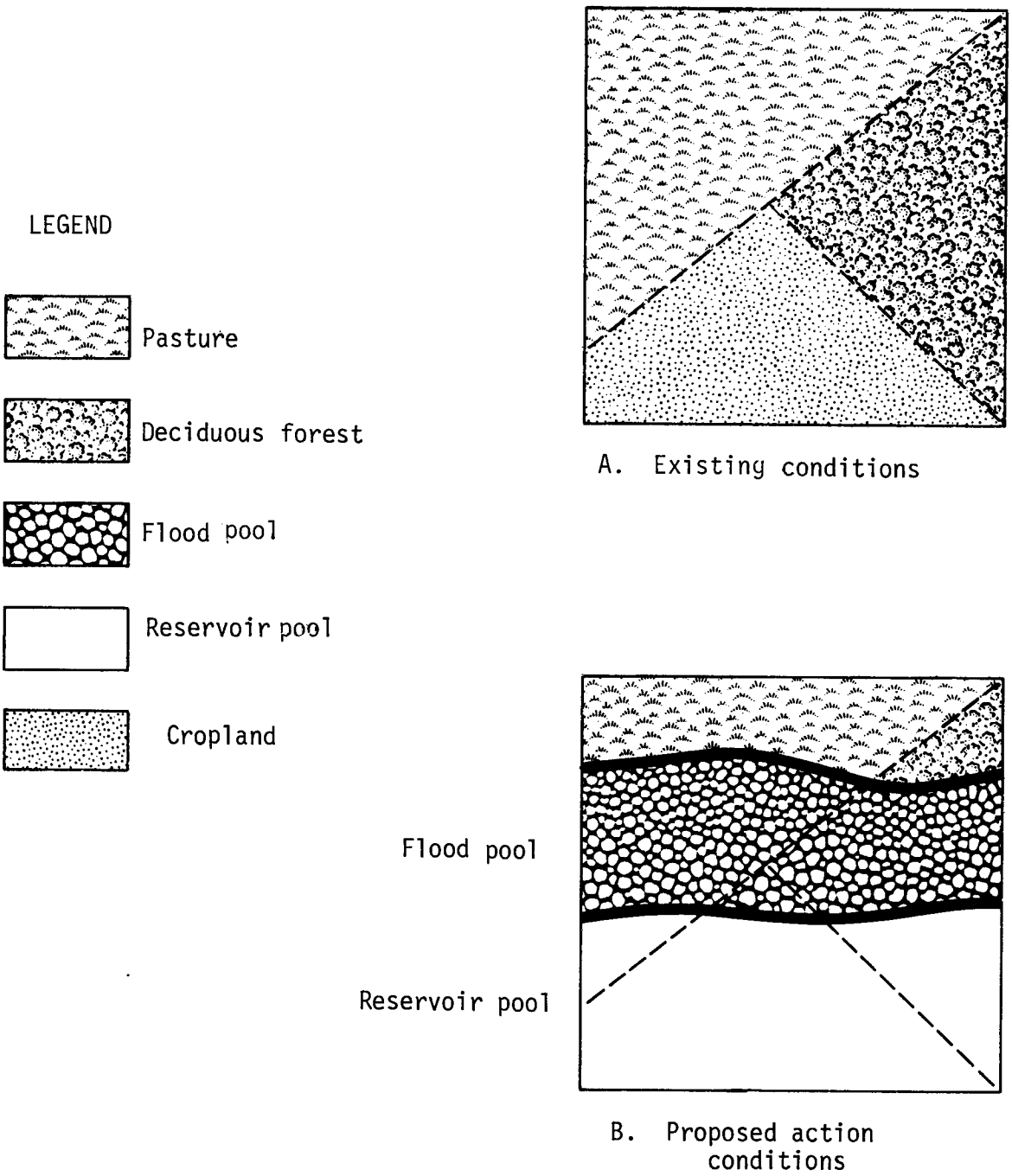

Figure 5-1. An example of a cover type map illustrating existing habitat conditions (A) and predicted conditions for target year 20 with a proposed action (B).

the impact analysis. Examples of such changes include construction impacts, implementation of a compensation plan, or other land use changes. The habitat assessment incorporates these changes by use of a period of analysis that includes prestart impacts (Figure 5-2). However, if no prestart changes are evident, then the life of the project and the period of analysis are the same.

Habitat Unit gains or losses are annualized by summing HU's across all years in the period of analysis and dividing the total (cumulative HU) by the number of years in the life of the project. In this manner prestart changes can be considered in the analysis. This calculation results in Average Annual Habitat Units (AAHU's).

The area of the shaded portion of the graph in Figure 5-3 represents the cumulative HU's for all years in the period of analysis and is calculated by summing the products of HSI and area of available habitat for all years in the period of analysis as follows:

$$\text{Cumulative HU's} = \sum_{i=1}^{p} H_i \, (A_i) \qquad (1)$$

where H_i = HSI at year i

A_i = area of available habitat at year i

p = the period of analysis (e.g., 100 years)

This is a generalized formula and requires that the HSI and area of available habitat be known for each year. However, a formula that requires only target year HSI and area estimates is:

$$\text{Cumulative HU's} = (T_2 - T_1)\left[\frac{A_1H_1 + A_2H_2}{3} + \frac{A_2H_1 + A_1H_2}{6}\right] \qquad (2)$$

where T_1 = first target year of time interval

T_2 = last target year of time interval

A_1 = area of available habitat at beginning of time interval

A_2 = area of available habitat at end of time interval

H_1 = HSI at beginning of time interval

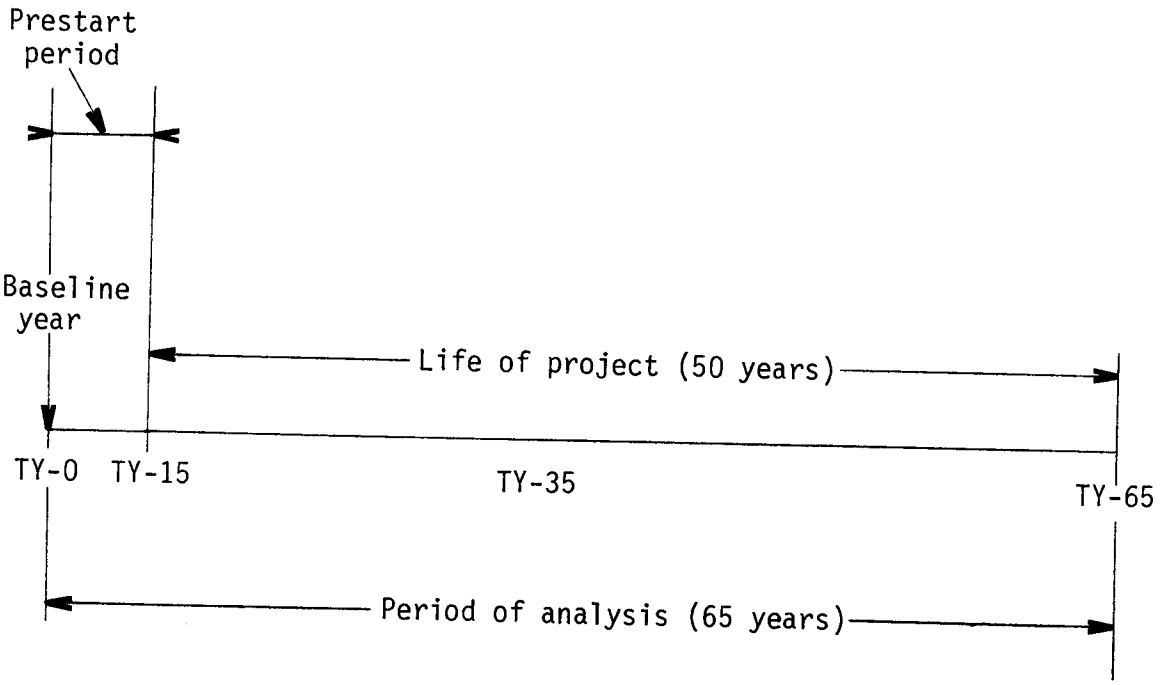

Figure 5-2. Relationship between the "life of the project" and the "period of analysis".

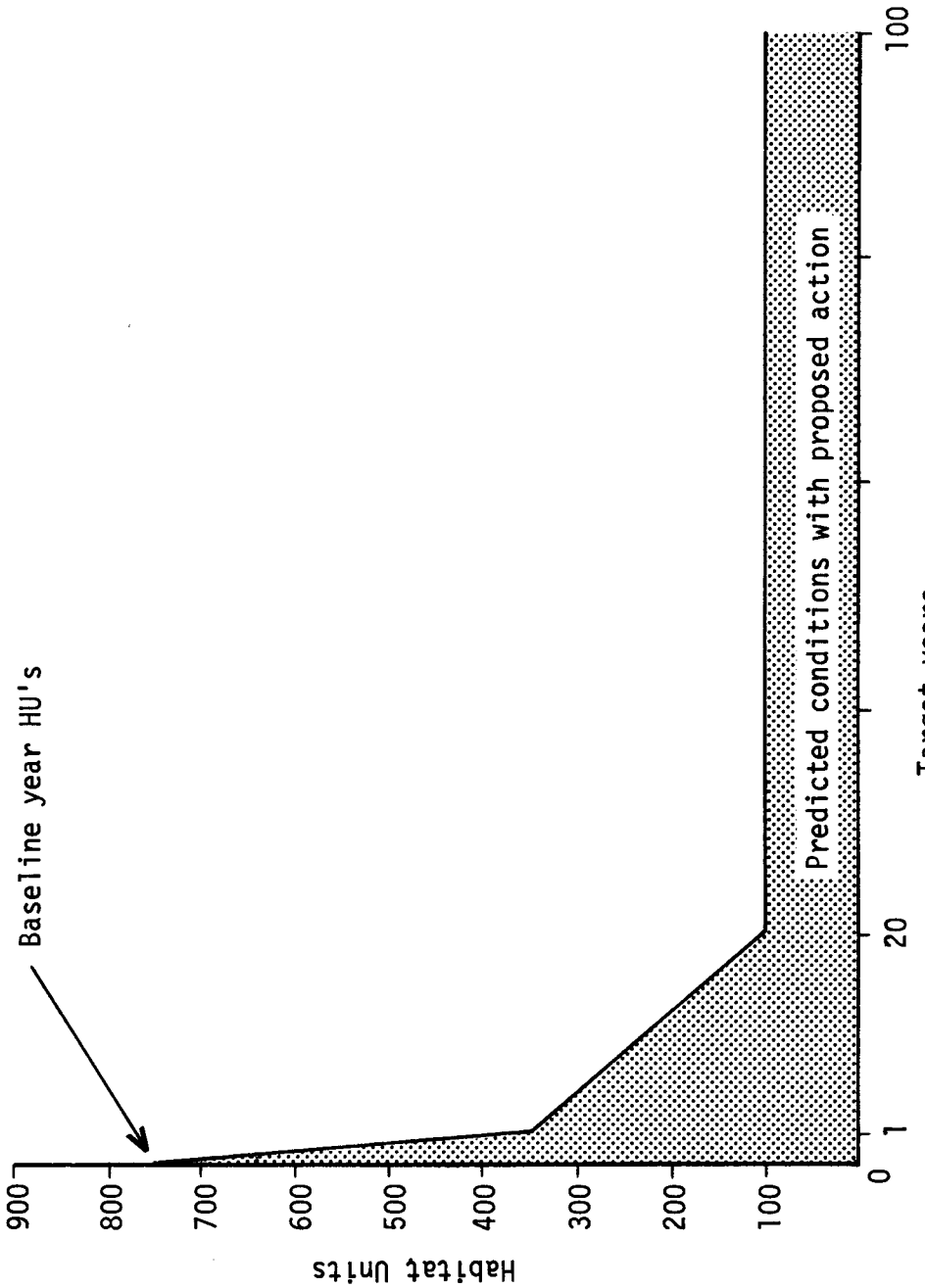

Figure 5-3. Change in white-tailed deer HU's for a hypothetical reservoir project. Shaded area represents the cumulative habitat availability with the proposed action.

H_2 = HSI at end of time interval

3 and 6 = constants derived from integration of HSI x Area for the interval between any two target years

Formula (2) is applied to the time intervals between target years. For the example in Figure 5-3, the formula must be applied for three time intervals: baseline to year 1, year 1 to year 20, and year 20 to year 100. The formula was developed to precisely calculate cumulative HU's when either HSI or area or both change over a time interval. The rate of change of HU's may be linear (either HSI or area is constant over the time interval), or curvilinear (both HSI and area change over the time interval); the formula will work in either case.

E. Calculating net impacts of a proposed action. The preceding example illustrates the calculation of AAHU's for one set of future conditions. However, determining the net impact of a proposed action requires that two future analyses be performed and compared to one another: 1) expected future conditions with the proposed action; and 2) the future without the proposed action. When comparing future conditions, the same baseline year and period of analysis must be used for each. Table 5-1 presents a hypothetical set of data for white-tailed deer habitat for the future with and the future without a proposed action.

Table 5-1. Target year habitat conditions for white-tailed deer for both the future with and the future without a proposed action.

Condition	Target year	Area (acres)	HSI value	Total HU
With proposed action	Baseline	1000	0.75	750
	1	500	0.70	350
	20	500	0.20	100
	100	500	0.20	100
Without proposed action	Baseline	1000	0.75	750
	1	1000	0.75	750
	20	900	0.60	540
	100	600	0.60	360

Using formula (2) for cumulative HU's, the AAHU calculations for the future with the proposed action are as follows:

Baseline - 1

A. $(1 - 0)\left[\frac{1000(0.75) + 500(0.70)}{3} + \frac{500(0.75) + 1000(0.70)}{6}\right] = 545.8$

Years 1-20

B. $(20 - 1)\left[\frac{500(0.70) + 500(0.20)}{3} + \frac{500(0.70) + 500(0.20)}{6}\right] = 4275$

Years 20-100

C. $(100 - 20)\left[\frac{500(0.20) + 500(0.20)}{3} + \frac{500(0.20) + 500(0.20)}{6}\right] = 8000$

Cumulative HU's = 545.8 + 4275 + 8000 = 12820.8

AAHU's = $\frac{12820.8}{100} = 128.2$

The AAHU calculations for the future without the proposed action are as follows:

Baseline - 1

A. $(1 - 0)\left[\frac{1000(0.75) + 1000(0.75)}{3} + \frac{1000(0.75) + 1000(0.75)}{6}\right] = 750$

Years 1-20

B. $(20 - 1)\left[\frac{1000(0.75) + 900(0.60)}{3} + \frac{900(0.75) + 1000(0.60)}{6}\right] = 12,208$

Years 20-100

C. $(100 - 20)\left[\frac{900(0.60) + 600(0.60)}{3} + \frac{600(0.60) + 900(0.60)}{6}\right] = 36,000$

Cumulative HU's = 750 + 12,208 + 36,000 = 48,958

AAHU's = $\frac{48,958}{100} = 489.6$

The net annual impact of the proposed action on white-tailed deer is calculated by using the formula:

$$\text{NET IMPACT} = \text{AAHU}_{\text{WITH}} - \text{AAHU}_{\text{WITHOUT}}$$

$$= 128.2 - 489.6$$

$$= -361.4 \text{ AAHU}$$

The net impact figure reflects in AAHU's the difference between future with and future without the proposed action conditions. An average of 361.4 fewer HU's will be available for deer every year during the life of the proposed action than would be available if the proposed action was not implemented. Figure 5-4 illustrates this relationship.

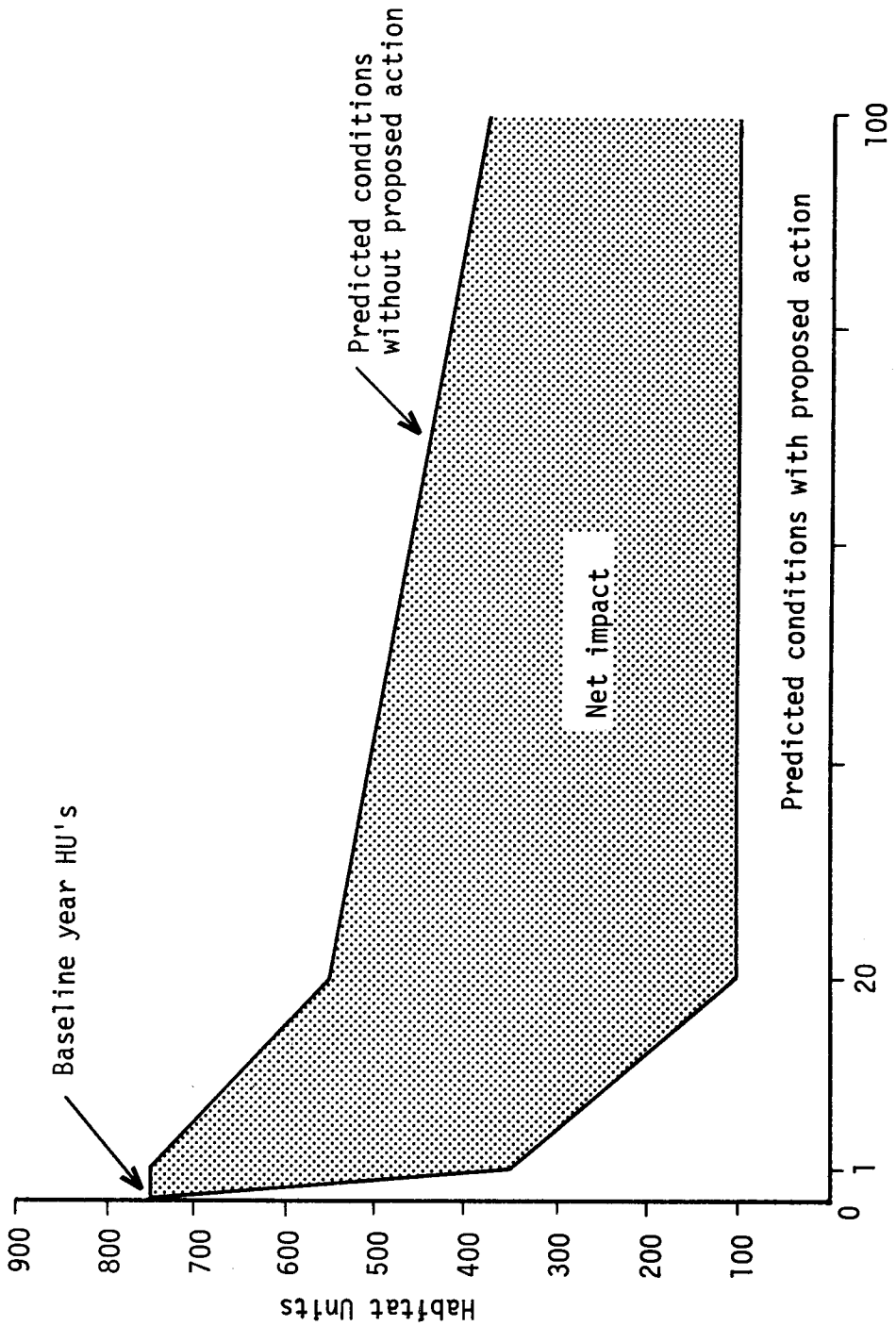

Figure 5-4. Relationship between baseline, conditions without a proposed action, conditions with a proposed action, and net impact.