

HABITAT SUITABILITY INDEX MODELS: DABBING DUCKS

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## Dabbling Ducks (Anas species)

### HABITAT USE INFORMATION

#### General

Dabbling ducks (Anas species) are a group of freshwater ducks that occur throughout the world. Those evaluated for the formulation of this HSI model are limited primarily to the United States and Canada and prefer rather shallow bodies of water such as marshes and freshwater ponds (Johnsgard, 1975).

#### Food

Ducks subsist on a variety of plant and animal foods. The relative proportions of each depend upon the season, availability, and species of duck involved. The abundance in the diet of animal foods increases for females during the breeding season (Serie and Swanson, 1976; Krull, 1970; Swanson and Meyer, 1977; Swanson, Meyer, and Serie, 1974; Krapu, 1974; Wheeler and March, 1979). The diets of laying mallard hens consisted of 52% flora, and 48% fauna (Wheeler and March, 1979). For other species of breeding ducks values were 72% fauna for gadwalls (Serie and Swanson, 1976) and 89% for blue-winged teals (Krapu, 1974). Aquatic insects, molluscs, and crustaceans comprise the bulk of animal food known to be consumed by waterfowl (Krull, 1970; Swanson, Meyer, and Serie, 1974). Juvenile mallards are highly dependent upon a high protein diet consisting of terrestrial and aquatic forms. As the birds mature, a gradual shift in the diet from fauna to flora occurs. The amount of fauna consumed was found to be 90% for juvenile mallards 1 to 6 days old, and 75% for those 13 to 18 days old. At 46 to 55 days old the changeover is complete with fauna comprising less than 1% of the diet (Chura, 1961). Predominant plant food items for most duck species consist of bulrush (Scirpus sp.), smartweed (Polygonum sp.), and duckweeds (Lemna sp.) (Zimmerman, 1953). Alkalai bulrush (Scirpus paludosus) has been found to be a very important food for pintails, mallards, shovelers, and green winged teal in California (Mall, 1969).

The availability of food items to waterfowl is a function of availability of water and salinity, the amount and distribution of submergent and emergent vegetation, and water depth.

The salt content of the water has a marked influence on the species composition and the relative abundance of the plant communities that serve as food for ducks (Swanson, Meyer, and Serie, 1974). Of the important emergent plant species common cattail was found to be the least salt tolerant, followed by hardstem bulrush, and then alkalai bulrush (Kaushik, 1963, cited by Christiansen and Low, 1970).

The abundance of invertebrates is influenced by the amount of submerged aquatic vegetation (Krull, 1970). Voigts (1976) found that the total invertebrate abundance increased as the emergent vegetation was replaced by submergent vegetation, but maximum numbers occurred where beds of submerged vegetation were interspersed with stands of emergent vegetation.

Water depths preferred for feeding by dabblers are related to the depth at which food items of both plant and animal origin occur, and to the feeding capabilities of the ducks. At Ogden Bay Refuge in Utah no vegetation developed in water areas over four feet deep due to poor light penetration resulting from turbidity. Waters from 4 to 30 inches deep developed dense stands of submerged aquatics such as sago pondweed and widgeon grass. Alkalai bulrush was generally found in areas from 0 to 10 inches deep, and hardstem bulrush and cattail in areas up to 30 inches deep (Nelson 1954).

In a study of wintering waterfowl in Texas a high correlation was found between water depth and feeding site. The dabbling ducks were found in depths averaging two feet deep and ranging from 12-32 inches (White and James, 1978). The dabbling ducks are adapted for foraging by "tipping-up" rather than diving for food (Johnsgard, 1975). Correspondingly, the loss of shallow feeding zones within a wetland complex is an important factor to waterfowl feeding ecology due to the availability of

bottom foods which is limited by depth (Swanson and Meyer, 1977; Swanson, Meyer, and Serie, 1974).

### Water

Dietary water requirements were not mentioned in the literature. Water requirements related to food and reproduction are discussed under the specific habitat requirements for each of the life requisites.

### Cover

Cover requirements reported in the literature generally apply to the breeding season. It is assumed that the cover needs of dabbling ducks are the same as the reproductive needs.

### Reproduction

Ducks utilize both wetlands and uplands for nesting purposes. Factors resulting in unsatisfactory nesting habitat conditions are silt-covered shallows, broad mud-flats, and absence of submergent vegetation in open water areas (Wolf 1955). Ryder (1961), in a study of waterfowl productivity in northern Utah, found that 65 percent of 68 dabbling nests were in emergents and 35 percent in upland cover. Clark (1977), in a study on production and nesting ecology of ducks in Oregon, found that preferred upland cover consisted of brush with tall grass whereas very dense bulrush-cattail zones were the preferred wetland habitat. Wolf (1955), in a study in northern Utah and southern Idaho, also found that cattail and bulrush were the principal nesting materials utilized by waterfowl. The preferred transition zone cover found by Clark (1977) was comprised of very dense stands of rushes, sedges, and various grasses. Hardstem bulrush, salt-grass, willow, and cattails were the dominant plants utilized by ducks at the Bear River Migratory Bird Refuge in Utah (Williams and Marshall, 1938).

The density and distribution of the required vegetation for nesting determines the level of suitability. Ducks nesting in emergent vegetation seemed dependent upon dense plant growth for nest foundations (Ryder, 1961). The size and distribution of openings in stands of emergent vegetation are important for pairs or broods (Wheeler and March, 1979). Kaminski and Prince (1981) found avian abundance and diversity were highest during years when emergent hydrophytes and open water cover approximately equal areas in a highly interspersed pattern.

Islands have been found to attract nesting waterfowl in numbers seldom found on the mainlands (Hammond and Mann, 1956). Miller and Collins (1954) have recorded heavy use of islands by ducks on the Tule Lake and Lower Klamath National Wildlife refuges. Islands within the .1 - 1.0 acre range have been observed to attract the greatest number of nesting pairs. In a 1982 survey of an Arizona wetland by L. A. Piest, nesting densities on islands averaging 0.1 to 1.0 acre averaged 46 nests per acre (Smith, 1983, personal communication). Duck nesting densities on islands averaging 0.3 to 1.0 acre at the Lower Souris National Wildlife Refuge in North Dakota have regularly been 20 - 80 nests per acre. On the same refuge a .2 acre island exceeded 200 nests per acre whereas a 7 acre island attracted only 14 pairs per acre (Hammond and Mann, 1956). A 9 acre island in Crane Lake, Saskatchewan supported approximately 17 pairs per acre (Sent, 1923).

The number of islands relative to the area of open water is also important for duck production. For an Arizona wetland with 15 islands (averaging .1-1.0 acre) within a 40 acre area of open water, 2,750 ducks were produced in one year, most of which were from the islands (Smith, personal communication, 1983).

Several factors are responsible for the attractiveness of islands to breeding ducks. Islands provide relative freedom from disturbances by mammals or birds. However, isolation from the mainland is critical. Predatory mammals have been observed to cross channels which are either marshy, or narrow ( $\leq 100$  feet). Where islands have been inaccessible to

predators hatching success has been about 90%, versus about 50% for mainland nest samples (Hammond and Mann, 1956).

Other advantages of islands are the greater capacity for territorial occupancy because of the high shoreline to land surface ratio, and the close proximity of water, food, lookout sites, and nesting cover (Hammond and Mann, 1956).

## HABITAT SUITABILITY INDEX (HSI) MODEL

### Model Applicability

Geographic area. This HSI model was developed for application within the wintering range occurring in the western United States. The breeding range is also considered where it overlaps with the wintering range in parts of the west-central United States.

Season. This model was developed to evaluate habitat quality during the wintering and breeding seasons. Due to the incidence of year-around residence by some species of waterfowl, breeding habitat was considered as well as winterseasons are assumed to be the same.

Cover types. This HSI model was developed to evaluate habitat in herbaceous wetlands (HW) (terminology follows that of the U.S. Fish and Wildlife Service 1981).

Minimum habitat area. Minimum habitat is defined as the minimum area of contiguous habitat that is required for a species to live and reproduce in an area. No specific information was found in the literature and will vary depending upon the species of dabbling duck being considered.

Model Description

Overview. Food and reproductive habitat requirements are considered in this model as indices of overall habitat suitability. Water and cover needs are assumed to be met by the more critical needs of food and nesting. Dabbling ducks are known to utilize upland habitat for nesting. However, since shallow-water feeding areas are a critical component for habitat suitability, this model assesses habitat quality only for herbaceous wetlands.

The following sections provide the documentation, and reasoning behind assumptions used in formulating the suitability index graphs with the habitat use information available.

The relationship between habitat variables, life requisites, cover types, and the HSI for dabbling ducks is illustrated in Figure 1.

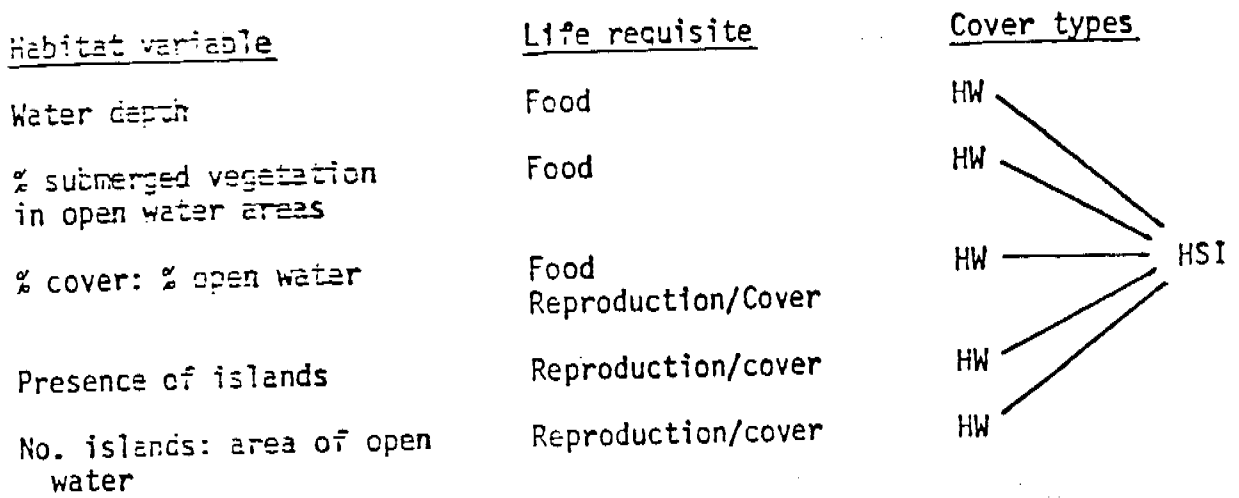


Figure 1. Relationships between habitat variables, life requisites, cover types, and the HSI model for the dabbling ducks.

Food Component. The suitability graphs developed for the evaluation of food requirements are based upon water depth, the percent of submerged vegetation in open water zones, and the distribution of open water zones within stands of emergent vegetation.

A water depth of two feet was found to be optimum for dabbling ducks. Suitability for feeding is assumed to be about 20% of optimum at 3.5 feet. This was the maximum feeding depth observed for most diving ducks by White and James (1978). As water depth increases, light penetration diminishes and limits plant growth. Since some emergent vegetation may be present, and the dabbling ducks do occasionally dive for food (Johnsgard, 1975), water depths greater than 3.5 feet are considered to be of some value.

Submerged aquatic vegetation is of value as plant food for waterfowl, and as habitat for associated invertebrate populations (Krull, 1970). It is therefore assumed that one hundred percent submerged vegetation in open water areas is optimum. Zero percent abundance is assumed to be of low suitability (SI of .1). This habitat variable affects waterfowl species density and diversity.

Two suitability graphs for the ratio of cover to open water were developed. The graphs are designed to reflect habitat situations that will 1) support an optimal number of breeding pairs ( $V_3$ ), and 2) attract a diversity of duck species ( $V_4$ ). The goal of this model is to predict the optimum habitat for both of these parameters. Breeding habitat is important for several species of waterfowl which are year-around residents in the area for which this model is being developed (Las Vegas Wash, Clark County, NV). The marsh is presently utilized for wildlife observation and species diversity will be increasingly important if Clark County's proposed park plan for the Las Vegas Wash is implemented.

Variable 4 is utilized to evaluate food and reproductive habitat. The habitat variable is indirectly correlated with food production in that the abundance and distribution of plant types and associated

invertebrate populations, valuable to ducks as food, are determined by cover to open water ratios.

One hundred percent cover (i.e., unbroken stands of emergent hydrophytes), is assumed to be of zero suitability. One hundred percent open water is assumed to be of low suitability (SI of .1).

Reproductive/Cover Component. The habitat variables utilized for evaluation of reproductive requirements are assumed to also correspond to cover needs. The variables involved are the ratio of cover to open water, the presence of islands, and the number of islands per area of open water.

Both suitability graphs which represent the percent cover to percent open water variable ( $V_3$  and  $V_4$ ) are utilized for the reproductive component (further explanations of this variable are presented in the preceding section). Due to the importance of the area, for which this model is being developed (Las Vegas Wash, Clark Co., NV), as a wetland park and wildlife observation area, the suitability graph based on species diversity ( $V_4$ ) is considered to be twice as important as the suitability graph based on production ( $V_3$ ).

When considering the success of islands for reproductive purposes, the presence of well isolated islands is considered to be optimum based on hatching success rates for ducks on such islands. The wetland for which this model was developed (Las Vegas Wash, Clark County, NV) is within close proximity to urban areas. Therefore, the vulnerability of breeding ducks and their young to predation is quite high. Under such circumstances the presence of well isolated islands is very beneficial to the breeding population of ducks. Breeding ducks utilizing islands which are separated from the mainland only by shallow marshy zones or narrow channels are assumed to have about the same hatching success rates as ducks using mainlands. For ducks using semi-isolated islands hatching success is assumed to be an average of the hatching success rates between ducks using the well isolated islands and those using the mainland/non-isolated islands.

The ratio between the number of islands and acreage of open water ( $V_6$ ) is assumed to be optimum at 1:2.67. This value is based upon a 1982 survey of duck production on an Arizona wetland by L. A. Piest (Smith, 1983, personal communication). No studies were found in the literature that documented higher duck production levels for similar habitat areas. The numbers and densities of breeding ducks and ducklings on this wetland are highly correlated with the presence of islands, however, other factors may have contributed to the high production levels. The portion of this wetland which is interspersed with islands and open water is fed by sewage effluent. Due to the enriched environment large quantities of aquatic invertebrates were available. This is an attractive feature during the breeding season due to the high protein requirements of nesting hens and their young. In addition, the islands were established with dense nesting cover (Piest, 1982).

Due to the wide variability of the possible ratios for the number of islands per acreage of open water, and the limited data available, a logarithmic scale was used to develop the suitability graph ( $V_6$ ). The lower limit for the number of islands per acre of open water (1:1000) is assumed to be equivalent to the presence of no islands. The upper limit (1:0) is considered mainland. The suitability for the mainland is based upon hatching success.

Suitability Index (SI) graphs for habitat variables. This section contains suitability index graphs that illustrate the habitat relationships described in the previous section. The data sources associated with documentation of the SI graphs are shown in Table 1.

Table 1. Data sources associated with documentation of the SI graphs.

<u>Variable</u>	<u>Source</u>
$V_1$	White and James, 1978 Krull, 1970 Swanson and Meyer, 1977
$V_2$	White and James, 1978 Krull, 1970 Connelly and Chesemore, 1980
$V_3, V_4$	Kaminski and Prince, 1981 Weller, 1975 Voigts, 1976
$V_5$	Hammond and Mann, 1956
$V_6$	Smith, 1983

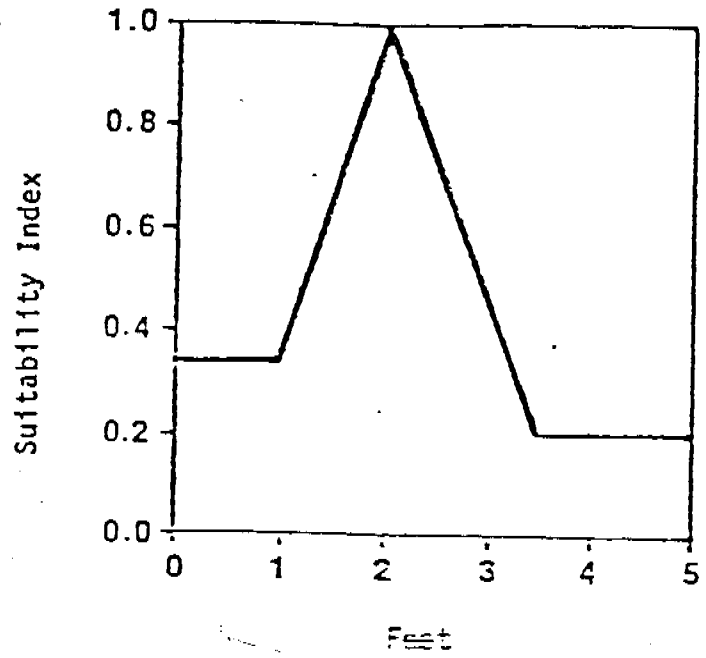
Cover  
type

Variable

HW

V<sub>1</sub>

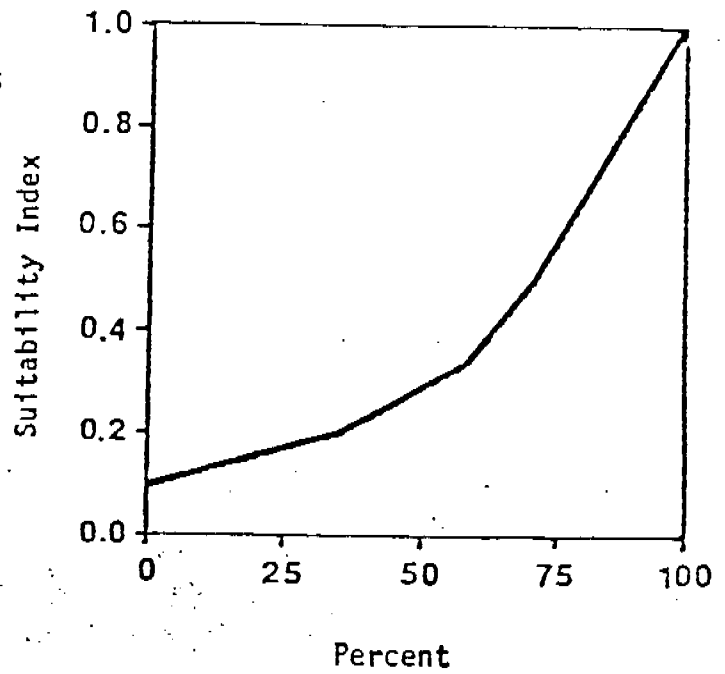
Water depth



HW

V<sub>2</sub>

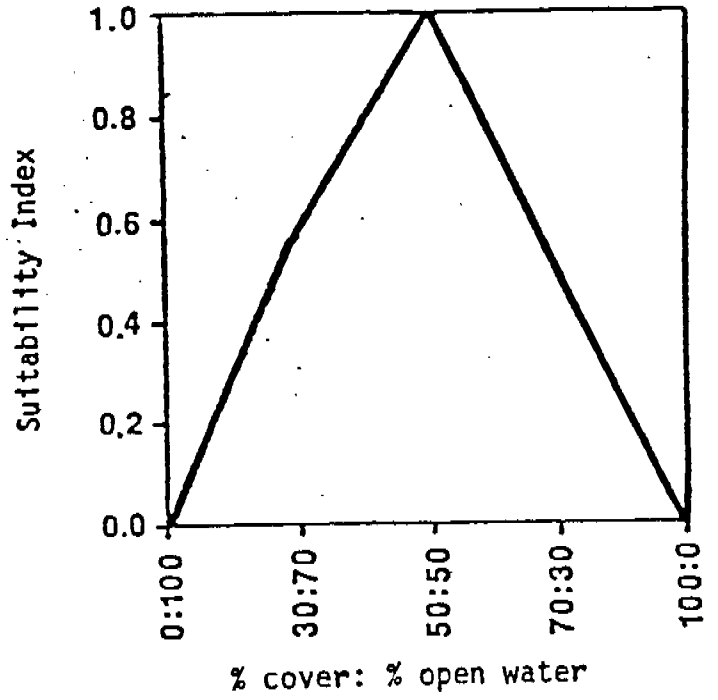
% submerged  
vegetation in  
open water areas



HW

V<sub>3</sub>

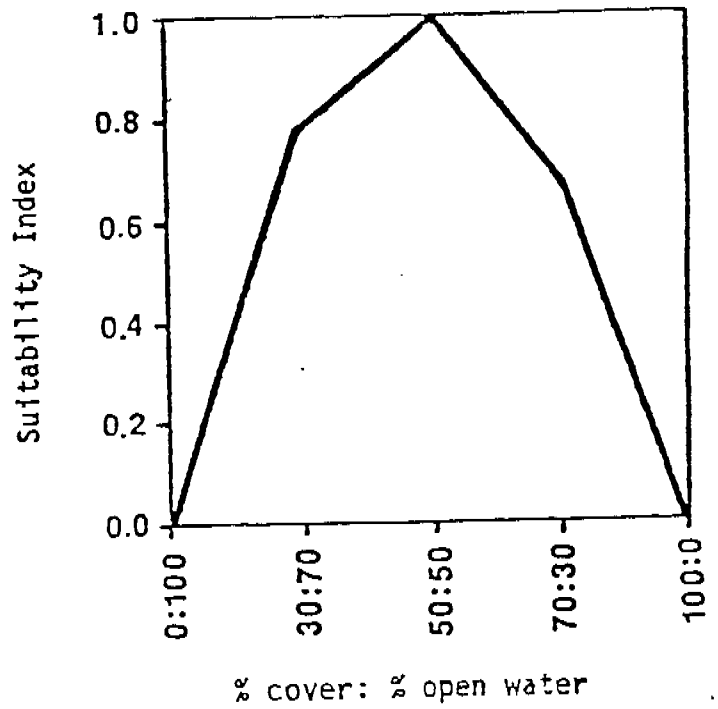
% cover: % open water (based on production)



HW

V<sub>4</sub>

% cover: % open water (based on species diversity)



Presence of islands

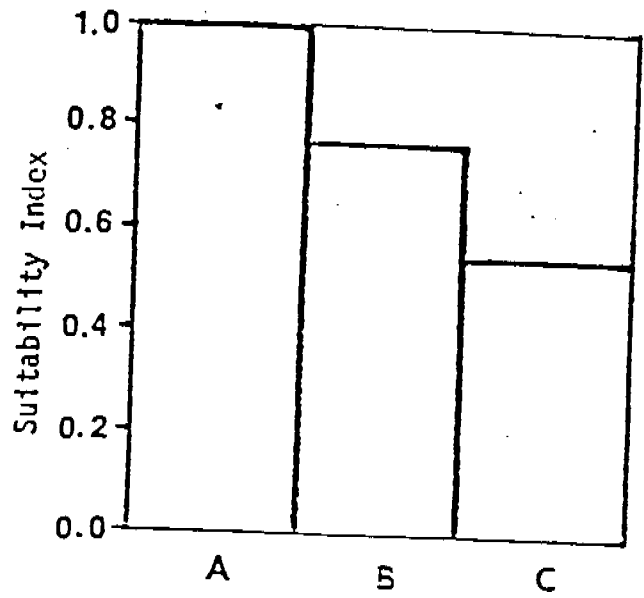
A = Well isolated islands (>100 feet of open water between the islands and the mainland).

B = Semi-isolated islands (20 - 100 feet of open water between the islands and the mainland).

C = 1 or 2

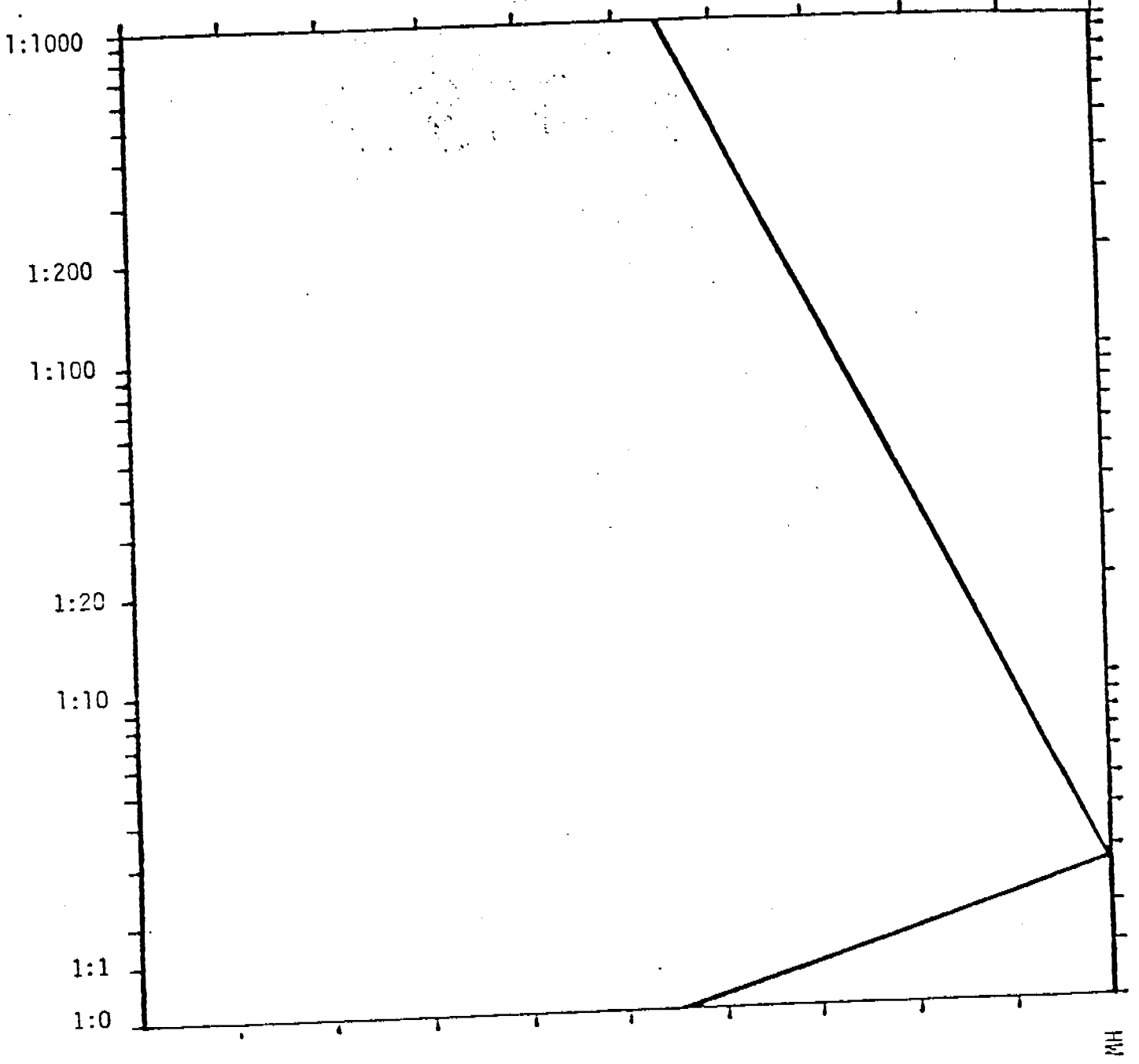
1) Non-isolated islands (<20 feet of open water between the islands and the mainland).

2) Mainland only (no islands).



Suitability Index

1.0  
0.9  
0.8  
0.7  
0.6  
0.5  
0.4  
0.3  
0.2  
0.1



HW  
V<sub>6</sub>

No. Islands:  
area (acres)  
of open water

Equations. The suitability index values for appropriate variables must be combined with the use of equations in order to obtain life requisite values for the dabbling ducks. A discussion and explanation of the relationships between variables was included under Model Description. The suggested equations for obtaining food and reproductive/cover values by cover type are as follows:

<u>Life requisite</u>	<u>Cover type</u>	<u>Equation</u>
Food	HW	$(V_1 \times V_2 \times V_4)^{1/3}$
Reproduction	HW	$(V_3 \times V_4^2 \times V_5 \times V_6)^{1/5}$

HSI determination. The HSI value for the dabbling ducks is equal to the arithmetic mean of the life requisites.

### Application of Model

Definitions of variables and suggested field techniques are presented in Table 2.

Table 2. Definition of variables and suggested measurement techniques.

<u>Variable (Definition)</u>	<u>Cover types</u>	<u>Suggested technique</u>
V <sub>1</sub> Water depth	HW	Transects
V <sub>2</sub> % submerged vegetation in open water areas	HW	Aerial photos
V <sub>3</sub> , V <sub>4</sub> % cover: % open water	HW	Aerial photos
V <sub>5</sub> Presence of islands	HW	Aerial photos
V <sub>6</sub> No. islands: area of open water	HW	Aerial photos

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