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# CORRELATION OF FOOD HABITS AND ABUNDANCE OF WATERFOWL, HUMBOLDT BAY, CALIFORNIA<sup>1</sup>

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## INTRODUCTION

Humboldt Bay, located along the northwest coast of California in Humboldt County, is over 200 nautical miles north of San Francisco and approximately 180 nautical miles south of Coos Bay, Oregon. The width of Humboldt Bay varies from one-half to about four miles, and its length is approximately 14 miles. At high tide the water in the bay covers 24.5 square miles and at low tide 7.8 square miles. Two long narrow sand spits separate the north and south bays of Humboldt Bay from the ocean (Anonymous, 1955).

Habitat types near the bay include coastal dunes on the west side, urban and agricultural on the north, east and south sides, and redwood forest type on the coastal mountains located immediately inland from the urban and agricultural areas (Yocom and Dasmann, 1957). The agricultural lands are used primarily for dairy cattle pasture. Remnants of tide channels, now blocked off by dikes, occur in the pasture lands. These old channels fill with fresh water during the rainy season in early fall to late spring. They provide habitat for aquatic plants used by waterfowl.

## RELATIVE ABUNDANCE OF WATERFOWL

An aerial inventory of the waterfowl in the Humboldt Bay area was taken by Bentley and Christianson (1957). Sixteen flights were made between October 16, 1956, and April 15, 1957. The highest concentration was noted in January 1957, when over 50,000 birds were present. From this inventory and other field studies the authors calculated the average number of waterfowl by species for each month included in the study. Monthly averages of waterfowl species were totaled which indicated the relative abundance of each species for the entire period. These numbers were converted to percentages (Table 1).

The seven most common waterfowl species utilizing Humboldt Bay were widgeon (*Marca americana*), black brant (*Branta nigricans*), pintail (*Anas acuta*), canvasback (*Aythya valisineria*), coot (*Fulica americana*), lesser scaup (*Aythya affinis*) and greater scaup (*Aythya marila*). Lesser and greater scaup were treated as one group because of the difficulty of differentiation in the field. However, we estimated the wintering populations of greater scaup in Humboldt Bay to be larger than the lesser scaup populations.

<sup>1</sup> Submitted for publication June, 1960.

TABLE 1

Relative Abundance of Waterfowl from October 16, 1956-April 15, 1957,  
Humboldt Bay, California

| Species                         | Percent of total | Species                 | Percent of total |
|---------------------------------|------------------|-------------------------|------------------|
| Widgeon.....                    | 47.1             | Mallard.....            | .3               |
| Black brant.....                | 20.2             | Shoveler.....           | .3               |
| Pintail.....                    | 15.6             | Whistling swan.....     | .2               |
| Canvasback.....                 | 4.2              | Scoter (3 species)..... | .1               |
| Coot.....                       | 2.7              | Ruddy duck.....         | .1               |
| Scaup (greater and lesser)..... | 2.5              | Gadwall.....            | trace            |
| Buffle-head.....                | .7               | Canada goose.....       | trace            |
| Redhead.....                    | .6               | Unidentified.....       | 4.8              |
| Green-winged teal.....          | .4               |                         |                  |

The relative abundance figure for scoters, which includes white-winged scoter (*Melanitta deglandi*), surf scoter (*Melanitta perspicillata*) and an occasional American scoter (*Oidemia nigra*), apparently is low (Table 1). These birds were difficult to identify and count from an airplane or ground station because they occur singly and in small groups dispersed over Humboldt Bay.

#### FOOD HABITS STUDIED

From 1953 to 1959 the authors compiled data on the food habits of Humboldt Bay waterfowl. Howard Leach, California Department of Fish and Game biologist, examined eight of the brant gizzards. Robert Talmadge, Willow Creek, aided in the identification of mollusks. A total of 393 gizzards of 11 species have been examined (Table A-1). Each plant item represents seeds unless otherwise indicated.

The methods used in analyzing food contents in the duck stomachs were the same as those discussed by Yocom (1951).

#### RELATIVE IMPORTANCE OF FOOD ITEMS

In evaluating the importance of the food sources to the total waterfowl population feeding in the Humboldt Bay area, food habits have been correlated with the abundance of each species of waterfowl. The volume of each food item eaten was assumed to indicate the importance of the item to the particular waterfowl species. To evaluate the importance of a specific food item to the total waterfowl population, we considered the total number of waterfowl of all species consuming a specific item. For each species of waterfowl the values in the percent of total volume column were multiplied by a figure representing the relative abundance of that waterfowl species in the Humboldt Bay area. This procedure results in a "volume index." The volume rates for a food item for all waterfowl consuming it were added resulting in a figure representing an index of the importance of each food item to the total local waterfowl population (Table A-2).

#### DISCUSSION

Eelgrass (*Zostera marina*) is by far the most abundant waterfowl food plant in this area and is available to all waterfowl utilizing the

open water of Humboldt Bay. Keller (1960) estimated 840 acres of eelgrass beds in the north and 2,015 acres in the south bays. Eelgrass was the principal food for widgeon (*Mareca americana*) and black brant (*Branta nigricans*) whereas the other waterfowl ate it only occasionally. Brant were, for the most part, dependent on eelgrass for food (Cottam and Monro, 1954, and Cottam, 1941), but widgeons fed on several different green plant foods in different locations.

Since widgeons in the Humboldt Bay area fed in fields and sloughs as well as on the bay, it appeared that their heavy utilization of eelgrass resulted from the availability and acceptability of the eelgrass rather than because of dependence upon it. The materials listed as "unidentified vegetation" under widgeon and brant in Table A-1 consisted principally of small fragments of eelgrass, clover, and grasses.

Analyses of foods consumed showed that pintails ate plant foods commonly found in the shallow areas of the bay and in marshlands adjacent to it. Eelgrass was found in only one sample.

Mallards (*Anas platyrhynchos*), which represented less than 0.5 percent of the wintering and migrating waterfowl populations, apparently obtained only a small portion of their food from the bay. The relatively small resident population and others that migrated to this area fed in the outlying ponds, marshes and streams where bulrushes (*Scirpus* spp.), spike rush (*Eleocharis macrostachya*), mare's tail (*Hippuris vulgaris*) and other species listed in Table A-1 were more abundant. When disturbed by hunters, they use the bay or the open ocean as escape areas. Eelgrass was found in only two samples. In recent years many of the coastal marshes have been eliminated by dikes, earth fill and drainage thus reducing the number of mallards that nest and winter there.

Green-winged teal (*Anas carolinensis*) also used the marsh areas along old tide channels and coastal marshes near the bay for most of their food supply.

Canvasbacks relied on animal food, pondweeds (*Potamogeton* spp.) and widgeon grass (*Ruppia maritima*). Eelgrass was found in only one specimen. Animal food from the bay was important in the diets of lesser and greater scaups and buffleheads (*Bucephala albeola*). Eelgrass apparently was not an important food for these three species, because it was found only in two greater scaup.

White-winged scoters ate primarily mollusks from the bay, whereas ruddy ducks (*Oxyura jamaicensis*) consumed primarily plant material of which widgeon grass was the most important.

Barley (*Hordeum vulgare*) was taken in relatively large amounts by mallards and pintails although little is grown in the area. Some barley may have been obtained from baited hunting ponds. Creeping spike rush occurred frequently in green-winged teal, pintail, mallard, and widgeon stomachs, and in small amounts in ruddy and bufflehead stomachs.

It should be noted that a food habits study indicates the food items consumed during the study, and not necessarily innate preferences of the waterfowl concerned. The food taken at any one time depends on both the preferences of the waterfowl and the availability of the food items. Thus as the availability of any food item changes, the food habits

and possibly the relative abundance of the waterfowl may change because of movement into and away from an area. For example, it seems likely that an increase in the availability of barley and other grains in this region could result in larger winter populations of pintails and mallards.

According to reports of people who lived in the Humboldt Bay area twenty or thirty years ago, geese other than black brant wintered there. At that time some fields on Table Bluff south of Humboldt Bay and elsewhere in the area were producing harvestable crops of mature oats (*Avena sativa*), barley and wheat (*Triticum aestivum*) which undoubtedly furnished feed for the geese and grain-eating ducks. Under a grain-growing type of agriculture there would be a change in the percentage of species of waterfowl wintering in this region.

This study indicates that at the present time eelgrass is the most important single food item to the waterfowl that pass through and winter in Humboldt Bay. From a management standpoint there is probably little that can be done to increase the production of eelgrass in this bay, however, the present eelgrass beds should be protected from future damage. Excess siltation, pollution, or certain oyster culture practices could reduce greatly the amount of eelgrass available to waterfowl (Keller, 1960).

### SUMMARY

In order to determine the relative importance of various food items to the total waterfowl population of the Humboldt Bay area, food habits and abundance of each species of waterfowl were correlated. Eelgrass, unidentified vegetation, clams, barley, clover, creeping spike rush, prairie bulrush, and widgeon grass, in order of importance, accounted for 94.6 percent of the volume indices. This indicated that at the present time eelgrass is the most important waterfowl food item in the Humboldt Bay area.

### LITERATURE CITED

- Anonymous  
1955. Humboldt Bay, California. A literature survey. University of Washington Department of Oceanography, 144 pp.
- Bentley, W. W. and E. R. Christianson  
1957. A continuous aerial inventory of waterfowl in the Humboldt Bay area. Unpublished report, Humboldt State College.
- Cottam, Clarence and David A. Monro  
1954. Eelgrass status and environmental relations. Jour. Wildl. Mgt. vol. 18, no. 4, pp. 449-460.
- Keller, Mathew  
1960. The distribution and importance of eelgrass (*Zostera marina*) in Humboldt Bay, California. Unpublished Master's thesis, Humboldt State College, Arcata, California.
- Moffitt, James and Clarence Cottam  
1941. Eelgrass depletion on the Pacific coast and its effect on the black brant. U.S. Dept. of the Int., F. and W. S., Wildl. Leaflet 204. 26 pp.
- Yocom, Charles F.  
1951. Waterfowl and their food plants in Washington. University of Washington Press, Seattle. 272 pp.
- Yocom, Charles and Raymond Dasmann  
1957. The Pacific coastal wildlife region. Naturegraph Co., San Martin, California. 112 pp.

## APPENDIX

TABLE A-1

Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items                                 | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|--|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>PINTAIL (49)</b><br>15.6% of population |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                          |           |                      |                |        |                         |             |
| <i>Hordeum vulgare</i>                     |           |                      |                |        |                         |             |
| Barley                                     | 10        | 20.4                 | 318.2          | 12.4   | 25.2                    | 392.4       |
| <i>Scirpus paludosus</i>                   |           |                      |                |        |                         |             |
| Prairie Bulrush                            | 16        | 32.6                 | 508.6          | 7.3    | 14.8                    | 230.7       |
| <i>Eleocharis macrostachya</i>             |           |                      |                |        |                         |             |
| Creeping Spike Rush                        | 24        | 49.0                 | 764.4          | 2.4    | 4.8                     | 75.1        |
| <i>Ruppia maritima</i>                     |           |                      |                |        |                         |             |
| Widgeon Grass                              | 5         | 10.2                 | 159.1          | 2.3    | 4.7                     | 73.2        |
| <i>Distichlis spicata</i>                  |           |                      |                |        |                         |             |
| Salt Grass                                 | 3         | 6.1                  | 95.2           | .4     | .8                      | 13.0        |
| <i>Rosa</i> sp.                            |           |                      |                |        |                         |             |
| Rose                                       | 3         | 6.1                  | 95.2           | .2     | .4                      | 6.7         |
| <i>Zostera marina</i> (vegetation)         |           |                      |                |        |                         |             |
| Eelgrass                                   | 1         | 2.0                  | 31.2           | .2     | .4                      | 6.3         |
| <i>Plantago</i> sp.                        |           |                      |                |        |                         |             |
| Plantain                                   | 1         | 2.0                  | 31.2           | .1     | .2                      | 3.2         |
| <i>Sparganium eurycarpum</i>               |           |                      |                |        |                         |             |
| Broad-Fruited Bur Reed                     | 1         | 2.0                  | 31.2           | .1     | .2                      | 3.2         |
| <i>Scirpus americanus</i>                  |           |                      |                |        |                         |             |
| Three Square                               | 2         | 4.1                  | 64.0           | .1     | .1                      | 1.7         |
| <i>Potamogeton</i> sp.                     |           |                      |                |        |                         |             |
| Pondweed                                   | 10        | 20.4                 | 318.2          | *trace | .1                      | 1.6         |
| <i>Sparganium</i> sp.                      |           |                      |                |        |                         |             |
| Bur Reed                                   | 3         | 6.1                  | 95.2           | trace  | trace                   | .5          |
| <i>Polygonum persicaria</i>                |           |                      |                |        |                         |             |
| Lady's-thumb                               | 3         | 6.1                  | 95.2           | trace  | trace                   | .5          |
| <i>Potamogeton pectinatus</i>              |           |                      |                |        |                         |             |
| Sago Pondweed                              | 2         | 4.1                  | 64.0           | trace  | trace                   | .3          |
| <i>Melilotus</i> sp.                       |           |                      |                |        |                         |             |
| Sweet Clover                               | 2         | 4.1                  | 64.0           | trace  | trace                   | .3          |
| <i>Galium</i> sp.                          |           |                      |                |        |                         |             |
| <i>Carex obnupta</i>                       |           |                      |                |        |                         |             |
| Slough Sedge                               | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| <i>Scirpus</i> sp.                         |           |                      |                |        |                         |             |
| Bulrush                                    | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| <i>Polygonum</i> sp.                       |           |                      |                |        |                         |             |
| Smartweed                                  | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| <i>Rumex</i> sp.                           |           |                      |                |        |                         |             |
| Dock                                       | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| <i>Ranunculus</i> sp.                      |           |                      |                |        |                         |             |
| Buttercup                                  | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| <i>Cornus</i> sp.                          |           |                      |                |        |                         |             |
| Dogwood                                    | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| <i>Hippuris vulgaris</i>                   |           |                      |                |        |                         |             |
| Mare's Tail                                | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| Unidentified Vegetation                    | 23        | 46.9                 | 731.6          | 17.0   | 34.7                    | 541.4       |
| <b>ANIMAL FOOD</b>                         |           |                      |                |        |                         |             |
| Unidentified Pelecypoda                    |           |                      |                |        |                         |             |
| Clams                                      | 12        | 24.5                 | 382.2          | 5.5    | 11.2                    | 175.7       |
| Unidentified Gastropoda                    |           |                      |                |        |                         |             |
| Gastropods                                 | 4         | 8.2                  | 127.9          | .7     | 1.3                     | 20.7        |
| Unidentified Mollusca                      |           |                      |                |        |                         |             |
| Mollusks                                   | 1         | 2.0                  | 31.2           | .4     | .8                      | 12.7        |
| Unidentified Arthropoda                    |           |                      |                |        |                         |             |
| Arthropod                                  | 1         | 2.0                  | 31.2           | trace  | trace                   | .2          |
| Total                                      |           |                      |                | 42.9   | 98.7                    |             |

TABLE A-1—Continued  
Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items                                | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|---|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>MALLARD (24)</b><br>0.3% of population |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                         |           |                      |                |        |                         |             |
| <i>Hordeum vulgare</i>                    |           |                      |                |        |                         |             |
| Barley.....                               | 7         | 29.2                 | 8.8            | 5.6    | 49.6                    | 14.9        |
| <i>Potamogeton</i> sp.                    |           |                      |                |        |                         |             |
| Pondweed.....                             | 11        | 45.8                 | 13.7           | 1.6    | 13.9                    | 4.2         |
| <i>Eleocharis macrostachya</i>            |           |                      |                |        |                         |             |
| Creeping Spike Rush.....                  | 14        | 58.3                 | 17.5           | .6     | 5.8                     | 1.7         |
| <i>Scirpus paludosus</i>                  |           |                      |                |        |                         |             |
| Prairie Bulrush.....                      | 4         | 16.7                 | 5.0            | .4     | 3.9                     | 1.2         |
| <i>Carex obnupta</i>                      |           |                      |                |        |                         |             |
| Slough Sedge.....                         | 1         | 4.2                  | 1.3            | .3     | 2.7                     | .8          |
| <i>Zostera marina</i> (vegetation)        |           |                      |                |        |                         |             |
| Eelgrass.....                             | 2         | 8.3                  | 2.5            | .3     | 2.2                     | .7          |
| <i>Hippuris vulgaris</i>                  |           |                      |                |        |                         |             |
| Mare's Tail.....                          | 5         | 20.8                 | 6.2            | .3     | 2.2                     | .7          |
| <i>Polygonum</i> sp.                      |           |                      |                |        |                         |             |
| Smartweed.....                            | 4         | 16.7                 | 5.0            | .2     | 1.8                     | .5          |
| <i>Ranunculus flabellaris</i>             |           |                      |                |        |                         |             |
| Yellow Water Crowfoot.....                | 1         | 4.2                  | 1.3            | .2     | 1.8                     | .5          |
| <i>Polygonum persicaria</i>               |           |                      |                |        |                         |             |
| Lady's thumb.....                         | 3         | 12.5                 | 3.8            | .2     | 1.3                     | .4          |
| <i>Scirpus americanus</i>                 |           |                      |                |        |                         |             |
| Three Square.....                         | 1         | 4.2                  | 1.3            | .2     | 1.3                     | .4          |
| <i>Sparganium</i> sp.                     |           |                      |                |        |                         |             |
| Bur Reed.....                             | 3         | 12.5                 | 3.8            | .2     | 1.3                     | .4          |
| <i>Potamogeton pectinatus</i>             |           |                      |                |        |                         |             |
| Sago Pondweed.....                        | 2         | 8.3                  | 2.5            | .1     | .9                      | .3          |
| <i>Anacharis</i> sp.                      |           |                      |                |        |                         |             |
| Waterweed.....                            | 1         | 4.2                  | 1.3            | trace  | .6                      | .2          |
| <i>Potamogeton natans</i>                 |           |                      |                |        |                         |             |
| Floating-Leaf Pondweed.....               | 1         | 4.2                  | 1.3            | trace  | .4                      | .1          |
| <i>Zostera marina</i> (seeds)             |           |                      |                |        |                         |             |
| Eelgrass.....                             | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Alopecurus</i> sp.                     |           |                      |                |        |                         |             |
| Foxtail.....                              | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Gramineae</i>                          |           |                      |                |        |                         |             |
| Unknown grass.....                        | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Polygonum natans</i>                   |           |                      |                |        |                         |             |
| Water persicaria.....                     | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Polygonum punctatum</i>                |           |                      |                |        |                         |             |
| Dotted Smartweed.....                     | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Polygonum lapathifolium</i>            |           |                      |                |        |                         |             |
| Pale persicaria.....                      | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Polygonum coccineum</i>                |           |                      |                |        |                         |             |
| Swamp Knotweed.....                       | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Rumex</i> sp.                          |           |                      |                |        |                         |             |
| Dock.....                                 | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Ranunculus</i> sp.                     |           |                      |                |        |                         |             |
| Buttercup.....                            | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Amaranthus</i> sp.                     |           |                      |                |        |                         |             |
| Amaranth.....                             | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Cirsium</i> sp.                        |           |                      |                |        |                         |             |
| Thistle.....                              | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| <i>Cornus</i> sp.                         |           |                      |                |        |                         |             |
| Dogwood.....                              | 1         | 4.2                  | 1.3            | trace  | trace                   | .01         |
| Unidentified vegetation.....              | 6         | 25.0                 | 7.5            | .7     | 6.0                     | 1.8         |

TABLE A-1—Continued  
Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items                      | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|---------------------------------|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>MALLARD (24)—Continued</b>   |           |                      |                |        |                         |             |
| <b>ANIMAL FOOD</b>              |           |                      |                |        |                         |             |
| Insects                         |           |                      |                |        |                         |             |
| Unidentified Insect.....        | 4         | 16.7                 | 5.0            | .2     | 1.8                     | .5          |
| Pelecypoda                      |           |                      |                |        |                         |             |
| Unidentified clams.....         | 2         | 8.3                  | 2.5            | .1     | .9                      | .3          |
| Gastropoda                      |           |                      |                |        |                         |             |
| Unidentified gastropods.....    | 1         | 4.2                  | 1.3            | .1     | .9                      | .3          |
| Total.....                      |           |                      |                | 11.3   | 99.3                    |             |
| <b>GREEN-WINGED TEAL (50)</b>   |           |                      |                |        |                         |             |
| .4% of population               |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>               |           |                      |                |        |                         |             |
| <i>Eleocharis macrostachya</i>  |           |                      |                |        |                         |             |
| Creeping Spike Rush.....        | 26        | 52.0                 | 20.8           | 1.5    | 15.0                    | 6.0         |
| <i>Ranunculus</i> sp.           |           |                      |                |        |                         |             |
| Buttercup.....                  | 5         | 10.0                 | 4.0            | .8     | 8.5                     | 3.4         |
| <i>Scirpus paludosus</i>        |           |                      |                |        |                         |             |
| Prairie Bulrush.....            | 19        | 38.0                 | 15.2           | .7     | 7.6                     | 3.0         |
| <i>Triticum</i> sp.             |           |                      |                |        |                         |             |
| Wheat.....                      | 2         | 4.0                  | 1.6            | .5     | 5.2                     | 2.1         |
| <i>Alopecurus</i> sp.           |           |                      |                |        |                         |             |
| Foxtail.....                    | 3         | 6.0                  | 2.4            | .4     | 4.3                     | 1.7         |
| <i>Potamogeton pectinatus</i>   |           |                      |                |        |                         |             |
| Sago pondweed.....              | 3         | 6.0                  | 2.4            | .2     | 2.4                     | 1.0         |
| <i>Polygonum lapathifolium</i>  |           |                      |                |        |                         |             |
| Pale persicaria.....            | 1         | 2.0                  | .8             | .2     | 2.1                     | .8          |
| <i>Distichlis spicata</i>       |           |                      |                |        |                         |             |
| Salt grass.....                 | 6         | 12.0                 | 4.8            | trace  | .3                      | .1          |
| <i>Ruppia maritima</i>          |           |                      |                |        |                         |             |
| Widgeon Grass.....              | 6         | 12.0                 | 4.8            | trace  | .3                      | .1          |
| <i>Carex obnupta</i>            |           |                      |                |        |                         |             |
| Slough Sedge.....               | 5         | 10.0                 | 4.0            | trace  | .3                      | 1.0         |
| <i>Chenopodium</i> sp.          |           |                      |                |        |                         |             |
| Goosefoot.....                  | 2         | 4.0                  | 1.6            | trace  | .1                      | .04         |
| <i>Carex</i> sp.                |           |                      |                |        |                         |             |
| Sedge.....                      | 2         | 4.0                  | 1.6            | trace  | .1                      | .04         |
| <i>Sparganium</i> sp.           |           |                      |                |        |                         |             |
| Bur Reed.....                   | 2         | 4.0                  | 1.6            | trace  | .1                      | .04         |
| <i>Scirpus validus</i>          |           |                      |                |        |                         |             |
| American Great Bulrush.....     | 1         | 2.0                  | .8             | trace  | trace                   | .02         |
| <i>Polygonum persicaria</i>     |           |                      |                |        |                         |             |
| Lady's Thumb.....               | 1         | 2.0                  | .8             | trace  | trace                   | .02         |
| <i>Polygonum hydropiper</i>     |           |                      |                |        |                         |             |
| Water Pepper.....               | 1         | 2.0                  | .8             | trace  | trace                   | .02         |
| <i>Juncus</i> sp.               |           |                      |                |        |                         |             |
| Rush.....                       | 1         | 2.0                  | .8             | trace  | trace                   | .02         |
| <i>Melilotus</i> sp.            |           |                      |                |        |                         |             |
| Sweet Clover.....               | 1         | 2.0                  | .8             | trace  | trace                   | .02         |
| <i>Hippuris vulgaris</i>        |           |                      |                |        |                         |             |
| Mare's Tail.....                | 1         | 2.0                  | .8             | trace  | trace                   | .02         |
| Unidentified Seed               | 1         | 2.0                  | .8             | trace  | trace                   | .02         |
| Unidentified Vegetation.....    | 12        | 24.0                 | 9.6            | 1.8    | 18.9                    | 7.6         |
| <b>ANIMAL FOOD</b>              |           |                      |                |        |                         |             |
| Gastropoda                      |           |                      |                |        |                         |             |
| Unidentified gastropods.....    | 3         | 6.0                  | 2.4            | 3.2    | 33.6                    | 13.4        |
| Mollusca                        |           |                      |                |        |                         |             |
| Unidentified mollusks.....      | 5         | 10.0                 | 4.0            | trace  | .3                      | .1          |
| Unidentified animal matter..... | 1         | 2.0                  | .8             | trace  | .5                      | .2          |
| Total.....                      |           |                      |                | 9.3    | 99.5                    |             |



TABLE A-1—Continued  
Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items                                   | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|--|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>BALDPATE (140)</b><br>47.1% of population |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                            |           |                      |                |        |                         |             |
| <i>Zostera marina</i> (Vegetation)           |           |                      |                |        |                         |             |
| Eelgrass                                     | 121       | 86.4                 | 4,069.4        | 120.0  | 81.0                    | 3,816.8     |
| <i>Trifolium</i> sp. (Vegetation)            |           |                      |                |        |                         |             |
| Clover                                       | 9         | 6.4                  | 301.4          | 8.9    | 6.0                     | 282.7       |
| <i>Eleocharis macrostachya</i>               |           |                      |                |        |                         |             |
| Creeping Spike Rush                          | 39        | 27.9                 | 1,314.1        | 5.2    | 3.5                     | 164.1       |
| <i>Hippuris vulgaris</i>                     |           |                      |                |        |                         |             |
| Mare's Tail                                  | 5         | 3.6                  | 169.6          | 1.5    | 1.2                     | 48.3        |
| <i>Melilotus</i> sp.                         |           |                      |                |        |                         |             |
| Sweet Clover                                 | 2         | 1.4                  | 65.9           | 1.2    | .8                      | 38.2        |
| <i>Sparganium</i> sp.                        |           |                      |                |        |                         |             |
| Bur Reed                                     | 2         | 1.4                  | 65.9           | .6     | .4                      | 10.2        |
| <i>Potamogeton pectinatus</i>                |           |                      |                |        |                         |             |
| Sago Pondweed                                | 5         | 3.6                  | 169.6          | .5     | .3                      | 14.6        |
| <i>Polygonum</i> sp.                         |           |                      |                |        |                         |             |
| Smartweed                                    | 1         | .7                   | 33.0           | .4     | .3                      | 12.7        |
| <i>Potamogeton</i> sp.                       |           |                      |                |        |                         |             |
| Pondweed                                     | 6         | 4.3                  | 202.5          | .3     | .2                      | 8.8         |
| Unidentified Grass blades                    | 4         | 2.9                  | 136.6          | .2     | .1                      | 5.09        |
| <i>Scirpus poludosus</i>                     |           |                      |                |        |                         |             |
| Prairie Bulrush                              | 6         | 4.3                  | 202.5          | trace  | trace                   | .9          |
| <i>Distichlis spicata</i>                    |           |                      |                |        |                         |             |
| Salt Grass                                   | 3         | 2.1                  | 98.9           | trace  | trace                   | .5          |
| <i>Scirpus acutus</i>                        |           |                      |                |        |                         |             |
| Viscid Bulrush                               | 2         | 1.4                  | 65.9           | trace  | trace                   | .3          |
| <i>Ranunculus</i> sp.                        |           |                      |                |        |                         |             |
| Buttercup                                    | 2         | 1.4                  | 65.9           | trace  | trace                   | .3          |
| <i>Polygonum persicaria</i>                  |           |                      |                |        |                         |             |
| Lady's Thumb                                 | 1         | .7                   | 33.0           | trace  | trace                   | .1          |
| <i>Rumex</i> sp.                             |           |                      |                |        |                         |             |
| Dock   | 1         | .7                   | 33.0           | trace  | trace                   | .1          |
| <i>Amaranthus</i> sp.                        |           |                      |                |        |                         |             |
| Amaranth                                     | 1         | .7                   | 33.0           | trace  | trace                   | .1          |
| <i>Plantago</i> sp.                          |           |                      |                |        |                         |             |
| Plantain                                     | 1         | .7                   | 33.0           | trace  | trace                   | .1          |
| Unidentified Seed                            | 2         | 1.4                  | 65.9           | trace  | trace                   | .3          |
| Moss   |           |                      |                |        |                         |             |
| Unidentified                                 | 1         | .7                   | 33.0           | trace  | trace                   | .1          |
| Unidentified Vegetation                      | 45        | 32.1                 | 1,511.9        | 8.8    | 5.9                     | 279.6       |
| <b>ANIMAL FOOD</b>                           |           |                      |                |        |                         |             |
| <b>Insecta</b>                               |           |                      |                |        |                         |             |
| Unidentified Insect                          | 4         | 2.9                  | 136.6          | .5     | .3                      | 16.4        |
| <b>Gastropoda</b>                            |           |                      |                |        |                         |             |
| Unidentified Gastropod                       | 1         | .7                   | 33.0           | trace  | trace                   | .1          |
| Unidentified Animal Matter                   | 1         | .7                   | 33.0           | trace  | trace                   | .1          |
| Total  |           |                      |                | 148.1  | 100.0                   |             |
| <b>CANVASBACK (17)</b><br>4.2% of population |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                            |           |                      |                |        |                         |             |
| <i>Potamogeton pectinatus</i>                |           |                      |                |        |                         |             |
| Sago Pondweed                                | 7         | 41.2                 | 173.0          | 4.2    | 15.7                    | 65.8        |
| <i>Ruppia maritima</i>                       |           |                      |                |        |                         |             |
| Widgeon Grass                                | 3         | 17.6                 | 73.9           | .7     | 2.6                     | 11.0        |
| <i>Potamogeton</i> sp.                       |           |                      |                |        |                         |             |
| Pondweed                                     | 1         | 5.9                  | 24.8           | trace  | trace                   | .08         |
| <i>Zostera marina</i>                        |           |                      |                |        |                         |             |
| Eelgrass                                     | 1         | 5.9                  | 24.8           | trace  | trace                   | .08         |

TABLE A-1—Continued  
Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items  | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|---|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>CANVASBACK (17)—</b><br><b>Continued</b>                 |           |                      |                |        |                         |             |
| <b>ANIMAL FOOD</b>  |           |                      |                |        |                         |             |
| <i>Pelecypoda</i>   |           |                      |                |        |                         |             |
| Unidentified Clams-----                                     | 11        | 64.7                 | 271.7          | 18.9   | 70.5                    | 296.08      |
| <i>Macoma</i> sp.<br>(Clam)-----                            | 1         | 5.9                  | 24.8           | 3.0    | 11.2                    | 47.0        |
| Total-----  |           |                      |                | 26.8   | 100.0                   |             |
| <b>LESSER SCAUP (13)</b><br>.3% of population               |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>   |           |                      |                |        |                         |             |
| <i>Triticum</i> sp.   |           |                      |                |        |                         |             |
| Wheat-----  | 1         | 7.7                  | 2.3            | .5     | 4.6                     | 1.4         |
| <i>Potamogeton</i> sp.                                      |           |                      |                |        |                         |             |
| Pondweed-----   | 3         | 23.1                 | 6.9            | .1     | .5                      | .2          |
| <i>Potamogeton pectinatus</i><br>Sago Pondweed-----         | 2         | 15.4                 | 4.6            | trace  | .2                      | .05         |
| <i>Eleocharis macrostachya</i><br>Creeping Spike Rush-----  | 3         | 23.1                 | 6.9            | trace  | .1                      | .04         |
| <i>Distichlis spicata</i><br>Salt Grass-----                | 2         | 15.4                 | 4.6            | trace  | .1                      | .03         |
| <i>Scirpus paludosus</i><br>Prairie Bulrush-----            | 2         | 15.4                 | 4.6            | trace  | .1                      | .03         |
| <i>Hippus vulgaris</i><br>Mare's Tail-----                  | 2         | 15.4                 | 4.6            | trace  | .1                      | .03         |
| <i>Sparganium</i> sp.<br>Bur Reed-----                      | 1         | 7.7                  | 2.3            | trace  | trace                   | .01         |
| <i>Sparganium eurycarpum</i><br>Broad Fruited Bur Reed----- | 1         | 7.7                  | 2.3            | trace  | trace                   | .01         |
| <i>Ruppia maritima</i><br>Widgeon Grass-----                | 1         | 7.7                  | 2.3            | trace  | trace                   | .01         |
| <i>Scirpus acutus</i><br>Viscid Bulrush-----                | 1         | 7.7                  | 2.3            | trace  | trace                   | .01         |
| <i>Polygonum persicaria</i><br>Lady's Thumb-----            | 1         | 7.7                  | 2.3            | trace  | trace                   | .01         |
| <i>Ranunculus flabellaris</i><br>Yellow Water Crowfoot----- | 1         | 7.7                  | 2.3            | trace  | trace                   | .01         |
| Unidentified Seed-----                                      | 1         | 7.7                  | 2.3            | trace  | trace                   | .01         |
| Unidentified Vegetation-----                                | 5         | 38.5                 | 11.6           | 3.09   | 34.7                    | 10.4        |
| <b>ANIMAL FOOD</b>  |           |                      |                |        |                         |             |
| <i>Macoma</i> sp.<br>Clam-----                              | 1         | 7.7                  | 2.3            | 5.0    | 45.5                    | 13.7        |
| Mollusca<br>Unidentified Mollusk-----                       | 1         | 7.7                  | 2.3            | 1.0    | 9.1                     | 2.7         |
| Crustacea<br>Unidentified Crustacean-----                   | 2         | 15.4                 | 4.6            | .5     | 4.6                     | 1.4         |
| Gastropoda<br>Unidentified Gastropod-----                   | 1         | 7.7                  | 2.3            | trace  | trace                   | .03         |
| Total-----  |           |                      |                | 10.1   | 99.6                    |             |
| <b>GREATER SCAUP (20)</b><br>2.3% of population             |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>   |           |                      |                |        |                         |             |
| <i>Zostera marina</i><br>Eelgrass-----                      | 2         | 10.0                 | 23.0           | .6     | 4.4                     | 10.2        |
| <i>Scirpus paludosus</i><br>Prairie Bulrush-----            | 1         | 5.0                  | 11.5           | trace  | trace                   | .2          |
| <b>ANIMAL FOOD</b>  |           |                      |                |        |                         |             |
| <i>Columbella carinata</i><br>Gastropod-----                | 7         | 35.0                 | 80.5           | 4.9    | 35.7                    | 82.1        |

TABLE A-1—Continued  
Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items                                  | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|---|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>GREATER SCAUP (20)—</b><br>Continued     |           |                      |                |        |                         |             |
| <i>Pelecyropoda</i>                         |           |                      |                |        |                         |             |
| Unidentified Clams                          | 10        | 50.0                 | 115.0          | 3.9    | 28.8                    | 64.2        |
| <i>Nassarius mendicus</i>                   |           |                      |                |        |                         |             |
| Gastropod                                   | 3         | 15.0                 | 34.5           | .8     | 5.9                     | 13.6        |
| <i>Macoma</i> sp.                           |           |                      |                |        |                         |             |
| Clam  | 3         | 15.0                 | 34.5           | 1.9    | 14.0                    | 32.2        |
| <i>Columbella aurantiaca</i>                |           |                      |                |        |                         |             |
| Gastropod                                   | 2         | 10.0                 | 23.0           | .7     | 5.2                     | 12.0        |
| Mollusca                                    |           |                      |                |        |                         |             |
| Unidentified Mollusk                        | 1         | 5.0                  | 11.5           | .4     | 2.9                     | 6.8         |
| <i>Nassarius fossatus</i>                   |           |                      |                |        |                         |             |
| Gastropod                                   | 1         | 5.0                  | 11.5           | .4     | 2.9                     | 6.8         |
| <i>Nassarius</i> sp.                        |           |                      |                |        |                         |             |
| Gastropod                                   | 1         | 5.0                  | 11.5           | trace  | trace                   | .08         |
| <i>Lacuna</i> sp.                           |           |                      |                |        |                         |             |
| Gastropod                                   | 1         | 5.0                  | 11.5           | trace  | trace                   | .08         |
| Total                                       |           |                      |                | 13.6   | 99.8                    |             |
| <b>BUFFLEHEAD (22)</b><br>.7% of population |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                           |           |                      |                |        |                         |             |
| <i>Scirpus paludosus</i>                    |           |                      |                |        |                         |             |
| Prairie Bulrush                             | 4         | 18.2                 | 12.7           | .3     | 5.1                     | 3.5         |
| <i>Ruppia maritima</i>                      |           |                      |                |        |                         |             |
| Widgeon Grass                               | 5         | 22.7                 | 15.9           | .1     | 1.9                     | 1.3         |
| <i>Potamogeton pectinatus</i>               |           |                      |                |        |                         |             |
| Sago Pondweed                               | 3         | 13.6                 | 9.5            | .1     | 1.8                     | 1.2         |
| <i>Potamogeton pectinatus</i>               |           |                      |                |        |                         |             |
| Sago Pondweed Tubers                        | 1         | 4.5                  | 3.2            | .1     | 1.6                     | 1.1         |
| <i>Hippurus vulgaris</i>                    |           |                      |                |        |                         |             |
| Mare's Tail                                 | 2         | 9.1                  | 6.4            | trace  | .2                      | .1          |
| <i>Potamogeton</i> sp.                      |           |                      |                |        |                         |             |
| Pondweed                                    | 2         | 9.1                  | 6.4            | trace  | .2                      | .1          |
| <i>Cirsium</i> sp.                          |           |                      |                |        |                         |             |
| Thistle                                     | 2         | 9.1                  | 6.4            | trace  | .2                      | .1          |
| <i>Sparganium</i> sp.                       |           |                      |                |        |                         |             |
| Bur Reed                                    | 2         | 9.1                  | 6.4            | trace  | .2                      | .1          |
| <i>Sparganium eurycarpum</i>                |           |                      |                |        |                         |             |
| Broad Fruited Bur Reed                      | 1         | 4.5                  | 3.2            | trace  | trace                   | .06         |
| <i>Trifolium</i> sp.                        |           |                      |                |        |                         |             |
| Clover                                      | 1         | 4.5                  | 3.2            | trace  | trace                   | .06         |
| <i>Rosa</i> sp.                             |           |                      |                |        |                         |             |
| Rose  | 1         | 4.5                  | 3.2            | trace  | trace                   | .06         |
| <i>Eleocharis macrostachya</i>              |           |                      |                |        |                         |             |
| Creeping Spike Rush                         | 1         | 4.5                  | 3.2            | trace  | trace                   | .06         |
| Unidentified Vegetation                     | 1         | 4.5                  | 3.2            | trace  | trace                   | .06         |
| <b>ANIMAL FOOD</b>                          |           |                      |                |        |                         |             |
| Hemiptera                                   |           |                      |                |        |                         |             |
| Unidentified Bug                            | 4         | 18.2                 | 12.7           | 1.6    | 25.7                    | 18.0        |
| <i>Pelecyropoda</i>                         |           |                      |                |        |                         |             |
| Unidentified Clams                          | 7         | 31.8                 | 22.3           | 1.1    | 17.5                    | 12.2        |
| Crustacea                                   |           |                      |                |        |                         |             |
| Unidentified Crab                           | 5         | 22.7                 | 15.9           | 1.0    | 15.3                    | 10.7        |
| Crustacea                                   |           |                      |                |        |                         |             |
| Unidentified Shrimp                         | 4         | 18.2                 | 12.7           | .9     | 14.5                    | 10.2        |
| <i>Lacuna</i> sp.                           |           |                      |                |        |                         |             |
| Gastropod                                   | 3         | 13.6                 | 9.5            | .6     | 9.6                     | 6.7         |
| <i>Gastropoda</i>                           |           |                      |                |        |                         |             |
| Unidentified Gastropod                      | 4         | 18.2                 | 12.7           | .2     | 3.5                     | 2.4         |

TABLE A-1—Continued

Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items   | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|--|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>BUFFLEHEAD (22)—</b><br>Continued                 |           |                      |                |        |                         |             |
| <i>Odestomia</i> sp.                                 |           |                      |                |        |                         |             |
| Gastropod.....                                       | 1         | 4.5                  | 3.2            | .1     | 1.6                     | 1.1         |
| <i>Columbella aurantiaca</i>                         |           |                      |                |        |                         |             |
| Gastropod.....                                       | 1         | 4.5                  | 3.2            | trace  | .8                      | .6          |
| <i>Columbella guspatha</i>                           |           |                      |                |        |                         |             |
| Gastropod.....                                       | 1         | 4.5                  | 3.2            | trace  | trace                   | .05         |
| Total.....   |           |                      |                | 6.1    | 99.7                    |             |
| <b>WHITE-WINGED SCOTER (17)</b><br>.1% of population |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                                    |           |                      |                |        |                         |             |
| <i>Ulex</i> sp.                                      |           |                      |                |        |                         |             |
| Sea Lettuce.....                                     | 1         | 5.9                  | .6             | trace  | trace                   | .001        |
| <b>ANIMAL FOOD</b>                                   |           |                      |                |        |                         |             |
| Pelecypoda   |           |                      |                |        |                         |             |
| Unidentified Clams.....                              | 15        | 88.2                 | 8.9            | 5.7    | 48.8                    | 4.9         |
| <i>Nassarius mendicus</i>                            |           |                      |                |        |                         |             |
| Gastropod.....                                       | 8         | 47.1                 | 4.7            | 4.6    | 17.4                    | 1.7         |
| <i>Ostra</i> sp.                                     |           |                      |                |        |                         |             |
| Oyster.....  | 1         | 5.9                  | .6             | 2.2    | 14.1                    | 1.4         |
| Crustacea  |           |                      |                |        |                         |             |
| Unidentified Crab.....                               | 4         | 23.5                 | 2.4            | 1.5    | 6.6                     | .7          |
| <i>Columbella aurantiaca</i>                         |           |                      |                |        |                         |             |
| Gastropod.....                                       | 2         | 11.8                 | 1.2            | 1.2    | 4.6                     | .5          |
| <i>Columbella carinata</i>                           |           |                      |                |        |                         |             |
| Gastropod.....                                       | 7         | 41.2                 | 4.1            | 1.0    | 3.6                     | .4          |
| <i>Olivella biplicata</i>                            |           |                      |                |        |                         |             |
| Olive Shell.....                                     | 2         | 11.8                 | 1.2            | .5     | 2.9                     | .3          |
| <i>Olivella pedroana</i>                             |           |                      |                |        |                         |             |
| Gastropod.....                                       | 1         | 5.9                  | .6             | .1     | 1.5                     | .2          |
| <i>Columbella gauspatha</i>                          |           |                      |                |        |                         |             |
| Gastropod.....                                       | 1         | 5.9                  | .6             | trace  | .3                      | .03         |
| <i>Nassarius fassatus</i>                            |           |                      |                |        |                         |             |
| Gastropod.....                                       | 1         | 5.9                  | .6             | trace  | trace                   | .001        |
| <i>Nassarius cooperi</i>                             |           |                      |                |        |                         |             |
| Gastropod.....                                       | 1         | 5.9                  | .6             | trace  | trace                   | .001        |
| <i>Littorina</i> sp.                                 |           |                      |                |        |                         |             |
| Periwinkle.....                                      | 1         | 5.9                  | .6             | trace  | trace                   | .001        |
| Total.....   |           |                      |                | 17.7   | 99.8                    |             |
| <b>RUDDY DUCK (21)</b><br>.1% of population          |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                                    |           |                      |                |        |                         |             |
| <i>Ruppia maritima</i>                               |           |                      |                |        |                         |             |
| Widgeon Grass.....                                   | 13        | 61.9                 | 6.2            | 6.2    | 68.1                    | 6.8         |
| <i>Potamogeton pectinatus</i>                        |           |                      |                |        |                         |             |
| Sago Pondweed.....                                   | 16        | 76.3                 | 7.6            | 1.6    | 17.4                    | 1.7         |
| <i>Potamogeton</i> sp.                               |           |                      |                |        |                         |             |
| Pondweed.....  | 2         | 9.5                  | .9             | .3     | 3.3                     | .3          |
| <i>Potamogeton pectinatus</i>                        |           |                      |                |        |                         |             |
| Sago Pondweed tubers.....                            | 1         | 4.8                  | .5             | .2     | 1.6                     | .2          |
| <i>Scirpus paludosus</i>                             |           |                      |                |        |                         |             |
| Prairie Bulrush.....                                 | 3         | 14.3                 | 1.4            | .1     | 1.2                     | .1          |
| <i>Eleocharis macrostachya</i>                       |           |                      |                |        |                         |             |
| Creeping Spike Rush.....                             | 4         | 19.0                 | 1.9            | .1     | 1.4                     | .1          |
| <i>Zostera marina</i>                                |           |                      |                |        |                         |             |
| Eelgrass.....  | 1         | 4.8                  | .5             | .1     | 2.0                     | .1          |

TABLE A-1—Continued

## Food of Eleven Species of Waterfowl, Humboldt Bay, California

| Food items                                     | Frequency | Percent of frequency | Frequency rate | Volume | Percent of total volume | Volume rate |
|--|-----------|----------------------|----------------|--------|-------------------------|-------------|
| <b>RUDDY DUCK (21)—</b><br>Continued           |           |                      |                |        |                         |             |
| <i>Hippurus vulgaris</i>                       |           |                      |                |        |                         |             |
| Mare's Tail-----                               | 2         | 9.5                  | 1.0            | trace  | .1                      | .01         |
| <i>Scirpus americanus</i>                      |           |                      |                |        |                         |             |
| Three Square-----                              | 1         | 4.8                  | .5             | trace  | trace                   | .005        |
| <i>Ranunculus</i> sp.                          |           |                      |                |        |                         |             |
| Buttercup-----                                 | 1         | 4.8                  | .5             | trace  | trace                   | .005        |
| <i>Cirsium</i> sp.                             |           |                      |                |        |                         |             |
| Thistle-----                                   | 1         | 4.8                  | .5             | trace  | trace                   | .005        |
| <b>ANIMAL FOOD</b>                             |           |                      |                |        |                         |             |
| Crustacea                                      |           |                      |                |        |                         |             |
| Unidentified shrimp-----                       | 2         | 9.5                  | 1.0            | .5     | 5.5                     | .6          |
| Total-----                                     |           |                      |                | 9.1    | 100.6                   |             |
| <b>BLACK BRANT (20)</b><br>20.2% of population |           |                      |                |        |                         |             |
| <b>PLANT FOOD</b>                              |           |                      |                |        |                         |             |
| <i>Zostera marina</i>                          |           |                      |                |        |                         |             |
| Elgrass-----                                   | 16        | 80.0                 | 1,616.0        | 18.2   | 81.3                    | 1,643.129   |
| Unidentified Vegetation-----                   | 12        | 60.0                 | 1,212.0        | 4.1    | 18.5                    | 373.700     |
| <i>Salicornia ambigua</i>                      |           |                      |                |        |                         |             |
| Pickleweed-----                                | 1         | 5.0                  | 101.0          | trace  | trace                   | .444        |
| Diatoms-----                                   | 2         | 10.0                 | 202.0          | trace  | trace                   | .909        |
| <b>ANIMAL FOOD</b>                             |           |                      |                |        |                         |             |
| Crustacea                                      |           |                      |                |        |                         |             |
| Unidentified Crustacea-----                    | 2         | 10.0                 | 202.0          | trace  | trace                   | 1.353       |
| Gastropoda                                     |           |                      |                |        |                         |             |
| Egg cases-----                                 | 1         | 5.0                  | 101.0          | trace  | trace                   | .444        |
| Total-----                                     |           |                      |                | 22.3   | 99.8                    |             |

\* Values carried to three decimal places were used in calculating the frequency and volume rates.

TABLE A-2 \*  
Summation of Volume Indices

| Food items                             | Percent<br>of volume<br>rates | Food items                           | Percent<br>of volume<br>rates |
|--|-------------------------------|--------------------------------------|-------------------------------|
| <i>Zostera marina</i> .....            | 60.9                          | <i>Carex obnupta</i> .....           | .01                           |
| Elgrass.....                           |                               | Slough Sedge.....                    |                               |
| Unidentified.....                      | 13.5                          | <i>Potamogeton pectinatus</i> .....  | .01                           |
| Vegetation.....                        |                               | Sago Pondweed Tubers.....            |                               |
| Pelecypoda.....                        | 6.1                           | <i>Scirpus</i> sp.....               | trace                         |
| Unidentified Clams.....                |                               | Bulrush.....                         |                               |
| <i>Hordeum vulgare</i> .....           | 4.5                           | <i>Rumex</i> sp.....                 | trace                         |
| Barley.....                            |                               | Dock.....                            |                               |
| <i>Trifolium</i> sp. (vegetation)..... | 3.1                           | <i>Cornus</i> sp.....                | trace                         |
| Clover.....                            |                               | Dogwood.....                         |                               |
| <i>Eleocharis macrostachya</i> .....   | 2.8                           | <i>Galium</i> sp.....                | trace                         |
| Creeping Spike Rush.....               |                               | Galium.....                          |                               |
| <i>Scirpus paludosus</i> .....         | 2.7                           | <i>Ranunculus flabellaris</i> .....  | trace                         |
| Prairie Bulrush.....                   |                               | Yellow Water Crowfoot.....           |                               |
| <i>Ruppia maritima</i> .....           | 1.0                           | <i>Polygonum lapathifolium</i> ..... | trace                         |
| Widgeon Grass.....                     |                               | Pale Persicaria.....                 |                               |
| <i>Potamogeton pectinatus</i> .....    | 1.0                           | <i>Anacharis</i> sp.....             | .2                            |
| Sago Pondweed.....                     |                               | Waterweed.....                       |                               |
| <i>Macoma</i> sp.....                  | .9                            | <i>Potamogeton natans</i> .....      | .2                            |
| Clam.....                              |                               | Floating Leaf Pondweed.....          |                               |
| <i>Hippuris vulgaris</i> .....         | .6                            | <i>Zostera marina</i> (seed).....    | .2                            |
| Mare's Tail.....                       |                               | Elgrass.....                         |                               |
| <i>Melilotus</i> sp.....               | .4                            | Gramineae.....                       | .2                            |
| Sweet Clover.....                      |                               | Unidentified Grass.....              |                               |
| Gastropoda.....                        | .4                            | <i>Polygonum punctatum</i> .....     | .2                            |
| Unidentified Gastropods.....           |                               | Dotted Smartweed.....                |                               |
| <i>Sparganium</i> sp.....              | .2                            | <i>Polygonum coccineum</i> .....     | .2                            |
| Bur Reed.....                          |                               | Swamp Knotweed.....                  |                               |
| Hemiptera.....                         | .2                            | <i>Amaranthus</i> sp.....            | .2                            |
| Unknown Bug.....                       |                               | Amaranth.....                        |                               |
| Mollusca.....                          | .2                            | <i>Cirsium</i> sp.....               | .2                            |
| Unknown Mollusk.....                   |                               | Thistle.....                         |                               |
| <i>Nassarius mendicis</i> .....        | .2                            | <i>Chenopodium</i> sp.....           | .2                            |
| Gastropod.....                         |                               | Goosefoot.....                       |                               |
| <i>Potamogeton</i> sp.....             | .2                            | <i>Carex</i> sp.....                 | trace                         |
| Pondweed.....                          |                               | Sedge.....                           |                               |
| <i>Distichlis spicata</i> .....        | .2                            | <i>Scirpus validus</i> .....         | trace                         |
| Salt Grass.....                        |                               | American Great Bulrush.....          |                               |
| <i>Polygonum</i> sp.....               | .2                            | <i>Polygonum hydropiper</i> .....    | trace                         |
| Smartweed.....                         |                               | Water Pepper.....                    |                               |
| <i>Columbella aurentiaca</i> .....     | .1                            | <i>Juncus</i> sp.....                | trace                         |
| Gastropod.....                         |                               | Rush.....                            |                               |
| Crustacea.....                         | .1                            | <i>Scirpus acutus</i> .....          | .4                            |
| Shrimp.....                            |                               | Viscid Bulrush.....                  |                               |
| <i>Lacuna</i> sp.....                  | .1                            | <i>Potamogeton pectinatus</i> .....  | .4                            |
| Gastropod.....                         |                               | Tubers (Sago Pondweed).....          |                               |
| <i>Nassarius fossatus</i> .....        | .1                            | <i>Salicornia ambigua</i> .....      | .6                            |
| Gastropod.....                         |                               | vegetation (Pickleweed).....         |                               |
| <i>Rosa</i> sp.....                    | .1                            | Diatoms.....                         | 1.1                           |
| Rose.....                              |                               | Moss.....                            | .2                            |
| Graminae.....                          | .1                            | <i>Ulex</i> sp.....                  | .2                            |
| Unidentified Grass vegetation.....     |                               | Sea Lettuce.....                     |                               |
| <i>Ranunculus</i> sp.....              | .04                           | <i>Littorina</i> sp.....             | .2                            |
| Buttercup.....                         |                               | Periwinkle.....                      |                               |
| <i>Triticum</i> sp.....                | .04                           | Arthropoda.....                      | .2                            |
| Wheat.....                             |                               | Unidentified Arthropod.....          |                               |
| Crustacea.....                         | .03                           | Unidentified Animal Matter.....      | .2                            |
| Unidentified.....                      |                               | <i>Nassarius</i> sp.....             | .1                            |
| <i>Sparganium eurycarpum</i> .....     | .02                           | Gastropod.....                       |                               |
| Broad Fruited Bur Reed.....            |                               | <i>Columbella gusata</i> .....       | .02                           |
| <i>Scirpus americanus</i> .....        | .02                           | Gastropod.....                       |                               |
| Three-square.....                      |                               | <i>Columbella carniata</i> .....     | .03                           |
| <i>Alopecurus</i> sp.....              | .02                           | <i>Olivella biplicata</i> .....      | .03                           |
| Foxtail.....                           |                               | Olive Shell.....                     |                               |
| <i>Ostra</i> sp.....                   | .02                           | <i>Olivella pedroana</i> .....       | .03                           |
| Oyster.....                            |                               | Gastropod.....                       |                               |
| <i>Polygonum persicaria</i> .....      | .01                           | <i>Nassarius cooperi</i> .....       | .03                           |
| Lady's Thumb.....                      |                               | Gastropod.....                       |                               |

\* Food items in the table arranged in order of frequency of occurrence.