AN ORNITHOLOGICAL SURVEY

OF

HAWAIIAN WETLANDS

BY

AHUIMANU PRODUCTIONS

FOR

U.S. ARMY, ENGINEER DISTRICT, HONOLULU

UNDER CONTRACT DACW 84-77-C-0036

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INTRODUCTION

INTRODUCTION

This ornithological survey of wetlands on the islands of Kauai, Oahu, Molokai, Maui and Hawaii was contracted to Ahuimanu Productions on 29 April, 1977, by the U. S. Army Corps of Engineers. The purpose of the survey was to provide data that would enable the Corps of Engineers to comply with the Fish and Wildlife Coordination Act (16 U.S.C.661-666C) and the Federal Endangered Species Act of 1973 (16 U.S.C.1531 et.seq.) during evaluation of Department of Army permit applications. The objectives of the study, as outlined in the Scope of Work, were: 1) to prepare an inventory of birds of the study sites; 2) to evaluate current condition of the sites as waterbird habitat; 3) to compile relevant biological data on wetland birds; and 4) to compile existing data on the study sites. This report presents results of field work conducted between 12 May, 1977 and 15 September, 1977.

Corps of Engineers Responsibility: On 18 October, 1972, Congress enacted the Federal Water Pollution Control Act Amendments of 1972, with the announced purpose of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. Section 404 of the FWPCA established a permit program, administered by the Secretary of the Army, to regulate the discharge of dredged and fill materials into waters of the United States. On 25 July, 1975, the Corps of Engineers published an interim final regulation in the Federal Register (Vol. 40, No. 144, Part IV). This regulation broadened the definition of the term "navigable waters" and established a schedule to implement permit requirements of Section 404.

On 19 July, 1977, a final version of "Regulatory Programs of the Corps of Engineers" was published in the Federal Register (Vol. 42, No. 138, Part II). Part 323 of this regulation describes policies and procedures to be followed by the Corps of Engineers in evaluation of applications for permits to discharge dredged or fill material into the waters of the United States pursuant to Section 404 of the FWPCA. Categories of waters subject to the Section 404 were defined as follows:

Category 1 - Coastal and inland waters, lakes, rivers and streams that are navigable waters of the United States, including adjacent wetlands.

Category 2 - Tributaries to navigable waters of the United States, including adjacent wetlands.

Category 3 - Interstate waters and their tributaries, including adjacent wetlands.

Category 4 - All other waters of the United States not identified in Categories 1-3, such as isolated lakes and wetlands, intermittent streams, prairie potholes, and other waters that are not part of a tributary system to interstate waters or to navigable waters of the United States, the degradation or destruction of which could affect interstate commerce.

The July, 1977 regulation also outlined general policies for evaluating permit applications, defined all the relevant terms involved and described which types of discharge require permits and which do not. Mechanisms for processing permit applications and procedures for enforcement of regulatory authority were also outlined.

Other Relevant Regulation Pertaining to Fish and Wildlife Resources: Expanded Corps of Engineers regulatory authority involving wetlands necessitates coordination with other agencies whose responsibility includes fish and wildlife resources inhabiting these areas. Under the Fish and Wildlife Coordination Act (16 U.S.C. 661-666c), any Federal agency that proposes to control or modify any body of water must first consult with the United States Fish and Wildlife Service (USF&WS), the National Marine Fisheries Service (NMFS), as appropriate, and with the head of the appropriate State agency exercising administration over the wildlife resources of the affected State. The State agency involved in Hawaii is the Division of Fish and Game (HDF&G), within the Department of Land and Natural Resources.

The Endangered Species Act of 1973 (Public Law 93-205:87 Stat. 884) is particularly relevant to Corps regulatory authority in Hawaii, because of endangered species of birds that inhabit Hawaiian wetlands. In passage of this Act, it was the intention of Congress to conserve threatened and endangered species and the ecosystems on which those species depend. Section 7 of the Act provides that Federal departments and agencies "shall utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to Section 4 of this Act and by taking such action necessary to insure that actions authorized, funded or carried out by them do not jeopardize the continued existence of such endangered species and threatened species or result in the destruction or modification of habitat of such species which is determined by the Secretary (of Interior), after consultation as appropriate with the affected States, to be critical".

In the most recent Federal list of endangered and threatened birds of the United States, 29 endemic taxa (species or subspecies) of Hawaiian birds are listed as "endangered" and one subspecies is listed as "threatened". All five of the endemic waterbirds are listed as "endangered" (Hawaiian Stilt, Hawaiian Coot, Hawaiian Gallinule, Hawaiian Duck, Laysan Duck). All of these, except the Laysan Duck, inhabit wetlands on the main islands. Some of these wetlands are managed by Federal or State agencies as refuges or sanctuaries for waterbirds.

In its role as the lead Department of Interior agency responsible for implementation of the 1973 Act, the USF&WS developed the concept of "Recovery Teams" to plan conservation programs for endangered and threatened species. Eight teams were established in Hawaii, one of which was the Hawaii Waterbird Recovery Team. This team has recently prepared a draft Hawaiian Waterbirds Recovery Plan (346) for the Hawaiian Stilt, Hawaiian Coot and Hawaiian Gallinule. In this draft plan, 17 areas are listed as "essential" habitats for these three waterbird species. It is anticipated that at least some of the areas on this list will be formally proposed in the Federal Register as "critical habitat", under the provisions of the 1973 Act. To date, habitat for only one endangered (non-wetland) species in Hawaii (Palila) has been formally designated as "critical habitat".

Report Organization: This report is organized into two volumes, with the primary purpose to allow retrieval of information on individual wetland sites and the waterbirds that inhabit Hawaiian wetlands.

In Volume One, techniques of field investigations, literature search and data interpretation are discussed in the Study Methods section. This is followed by a section called Wetlands, which provides introductory general information on wetland habitat and a brief historical examination of wetlands in the Hawaiian Islands. In the Waterbirds section of the report, a brief overview of wetland birds, and a historical review of waterbirds in Hawaii, are included. Effects of dredging and filling on waterbird habitat are many and varied, but an overview of this topic prevents unnecessary redundancy in the discussions of individual sites. Species Accounts provide pertinent information on endemic, indigenous and introduced wetland birds. Review of data in these accounts if fundamental to interpretation of site discussions , and particularly the evaluation of waterbird habitat in specific wetlands. The Bibliography consists of pertinent published and unpublished documents, and a listing of persons who contributed relevant information in the way of personal communications. All of these sources of information are referenced by number throughout this report. Data on individual wetland sites are summarized in six tables within the Appendix. Also included in this section of Volume One are HDF&G/USF&WS count data, a glossary and a list of plants mentioned in the report.

In Volume Two (Site Discussions), the results of field work and accumulation of historical data on wetlands are presented. A total of 78 wetland areas on five islands are treated individually, although several large areas are made up of more than one wetland site. Most site discussions are divided into six major topics: habitat description, non-avian wildlife, non-waterbird avifauna, waterbirds observed, habitat evaluation and the potential impact of dredge/fill activities. Other sites of less significance to waterbirds are treated in groups.

STUDY METHODS

Introduction

The Corps of Engineers provided the contractor (Ahuimanu Productions) with a series of topographic maps delineating wetland sites to be visited on Kauai, Oahu, Molokai, Maui and Hawaii. The basis for this listing of sites was an earlier contracted aerial photo survey of wetlands in the State as part of the Coastal Zone Management Program. During our aerial reconnaissance and field survey, it was determined that some wetlands were not on the original list. To the extent possible within the limited time available, the field survey was expanded to include some of those areas known to be of significance to waterbirds. However, it should be kept in mind in review of this report that many small ephemeral or artificial wetland sites, not included in this survey, may provide important waterbird habitat, particularly when considered together. Also, several thousand acres of high elevation forested bogs that provide important habitat for many endemic forest birds were not included in this survey, under prior agreement with Corps of Engineers representatives (i.e. Alakai Swamp, Mt. Kaala Bog). Presumably Corps permit jurisdiction over these areas will necessitate survey at a later date.

Literature Survey

A wide variety of published and unpublished material was reviewed in the completion of this study. Every issue (November, 1939 - August, 1977) of the Hawaii Audubon Society journal Elepaio, was reviewed in an attempt to build a historical file on wetland areas and to derive historical data on waterbird populations at selected sites. The Hawaii Audubon Society also published results of annual "Christmas Counts" in the Elepaio. In December of each year, several birdwatchers count birds at several locations during a single day. Until recently, "Christmas Counts" included only areas within a 25 mile radius of the center of Honolulu. Recent counts have included limited areas on the islands of Kauai and Hawaii. These data are referred to where they are relevant to specific site discussions. The published literature on Hawaii's waterbirds and wetlands is small, but contributed important historical information. Other material on Hawaii's wetland areas included environmental impact statements on development projects, fish pond surveys, archaeological studies and results of short-term limnological studies. Published literature on closely related waterbird species and mainland wetlands was reviewed for comparative data.

Data provided by State biologists included results of joint State/Federal semiannual waterbird census activities (see Appendix), Job Progress Reports (unpublished records of continuing census activities and studies of waterbird species), and review drafts of the Hawaii Waterbird Recovery Plan (346). U. S. Fish and Wildlife Service personnel provided access to files containing site surveys, Engineering Land Acquisition Reports (preliminary habitat surveys for prospective refuge areas), and environmental impact statements on specific wetlands. Most of the USF&WS data were generated since 1964.

It was clear prior to initiating this survey that our bird counts at wetland areas frequently visited by State and Federal biologists would add little in themselves to the historical data which have been accumulated for these sites. This was particularly true in the case of migratory waterfowl, few of which were in the Islands during the short time period available for this field work. For these reasons, we relied heavily upon historical data collected by State and Federal biologists for these sites. Unfortunately, historical count data varied considerably in relevance to the current study due to a lack of consistency in habitat coverage and wide variations in environmental parameters during earlier surveys. Problems in interpretation of these data are treated within individual wetland site discussions and in the Species Accounts.

Personal Interviews

A great number of people were contacted during this study as a source of information on Hawaii's waterbirds and on specific wetland areas (see Bibliography, page 64). Several State and Federal biologists provided unpublished information based on many years of accumulated experience. Participants in this study accompanied these biologists on surveys of selected areas, taking advantage of the opportunity in the field to gather additional information. Also, attempt was made to contact one or more landowners or lessees at most wetland areas, either in the field during survey or by phone at a later date. Data provided by these sources proved very helpful in completing site reports.

Aerial Reconnaissance and Photography

Wetland sites on all islands were surveyed by air, using reconnaissance aircraft. Notes on habitat condition were recorded and aerial photos were taken where weather and air traffic conditions permitted. Printed photos of wetland sites were carried in the field during ground surveys and used to identify vegetation types and to note any significant observations. These photos proved very helpful in evaluating habitat condition and in mapping the distribution of waterbirds.

Study Personnel

The Principal Investigator in this research project was Dr. Robert Shallenberger, President of Ahuimanu Productions. Dr. Shallenberger's responsibilities included: (1) planning of initial and follow-up field surveys, (2) aerial reconnaissance, (3) development and standardization of survey techniques, (4) initial survey of wetlands not covered by other participants, (5) follow-up survey of most wetlands, (6) habitat evaluation and impact assessment of wetlands based on recorded notes of Field Research Associates, historical data and information gathered by P.I., (7) compilation of published and unpublished historical data on wetlands and waterbirds, and (8) preparation of text for final report. Dr. Shallenberger was assisted in both field and office work by a Research Assistant, Mr. Greg Vaughn. Mr. Vaughn was also responsible for aerial photography, preparation of figures in this report, and portions of the data compilation phase of the study.

The Principal Investigator was assisted in the compilation of field data on wetlands by three Field Research Associates. These participants, with their research and teaching affiliation, included:

Sheila Conant, M.S., Ph.D.	University of Hawaii
Phillip Bruner, M.S.	Brigham Young University, Hawaii Campus
H. Douglas Pratt, M.S.	Louisiana State University.

All three Field Research Associates are highly competent ornithologists with considerable field research experience on islands covered in this survey and on the mainland. They were each very familiar with the bird species and many of the survey wetlands prior to the initiation of this project.

Field Survey

All field work was conducted by the Principal Investigator and Field Research Associates, accompanied on several trips by the Research Assistant. Duration of initial survey visit varied considerably with the size and condition of the site and with variations in accessibility. Most sites were surveyed a minimum of twice to detect variations in waterbird use, and to make certain that important waterbird habitat was covered adequately. Some sites were visited as many as six times during the contract period, particularly when waterbird breeding activity was monitored over an extended period. Access was denied by the landowner at 2 sites. Two high elevation areas on our original list were not visited (Kipahulu Valley bog and Na Manu'a Ha'alou). It is very unlikely that these sites are of any significance to waterbirds, but they are both within forest that supports several native bird species, some of which are listed as endangered. Most of the wetland areas included in this survey had been visited by the Principal Investigator and Field Research Associates on several occasions prior to the start of the survey. Data and experience accumulated during this previous work was important in the successful completion of this study and in the evaluation of particular wetland sites.

Effort was made in this study to minimize disturbance of birdlife in wetlands, particularly within refuge areas. In most sites, all portions of the area that could not be viewed clearly with binoculars or spotting scope were visited on foot or by rubber canoe to accomplish an adequate evaluation of the use of habitat areas by wetland birds.

Standardized methods of data recording were established for field survey work to insure compatibility of data and to simplify preparation of site accounts for this report. An outline of topics to be included in the site report was carried into the field, along with aerial photographs and topographic maps (see next page). Sites were either mapped in field notes or pertinent information was drawn onto site photographs.

WETLAND SURVEY NOTES

I. Survey Data
   a. Site Name
   b. Date
   c. Time
   d. Weather
   e. Itinerary
   f. Photo record
   g. Access info

II. Habitat Data
   a. Wetland type
   b. Water source
   c. Physiography
   d. Past Use
   e. Present use
   f. Current impacts
   g. Potential effex of dredge/fill

III. Faunal Survey
   a. Non wetland birds
   b. Terrestrial verts
   c. Aquatic verts
   d. Aquatic invert

IV. Waterbird Survey
   a. Species List
   b. Species Description (for each)
      (1) Numbers (age/sex), distrib.
      (2) Breeding behavior
      (3) Feeding behavior
      (4) other behavior
      (5) Inter and intraspec. behavior
      (6) Descrip. of species habitat
      (7) Potential for maint./improve

V. Recommendations for future research
VI. Landowner Interview

Explanation of Data Recorded on Survey

I. Survey Data

a. Site name: For those wetlands where long-established names were known there was no problem in identifying the site. However, several wetland areas are known by a variety of names, and some are unnamed. Some were identified on survey by the nearest prominent landmark on the topographic map. Discussions with State and Federal biologists during and after survey made it possible to relate our data to names that had been given to poorly-known sites during earlier waterbird counts.

b. Date: self-explanatory

c. Time: The time of day and duration of each site visit were recorded. Any variation in bird numbers or distribution that appeared to be a

function of the time of day was noted.

d. Weather: Notations in this category included cloud cover, rainfall, wind speed and direction. Where appropriate, tidal conditions were noted.

e. Itinerary: The sequence of activities during a site visit were recorded, including a description of the route taken. The primary purpose of this information was to aid in the interpretation of data and to insure maximum site coverage during subsequent visits.

f. Record of photos: Pertinent data on color photos taken on the ground during survey was recorded in field notes. These photos aided in the identification of vegetation and in the interpretation of field notes during site evaluation.

g. Access: Information was recorded on how to locate the site, methods of access into the area, which landowners to contact, and how to avoid any problems that may have been encountered.

II. Habitat Data

a. Wetland type: Attempt was made to broadly categorize each wetland visited, including any additional narrative that might improve the description. (See page 14)

b. Water source: Where possible, the source(s) of water into a wetland was identified in the field (stream, springs, rainfall, drainage ditch, tidal, flood dependent, etc.). Evidence of fluctuation in water levels was also noted. In some cases landowner interview or published data provided this information.

c. Physiography: This broad descriptive category of information included topography of surrounding area (slope, vegetation, relationship to the wetland), condition of open water in the wetland, general vegetative description, type of bottom, water depth (measured at various locations with probe), and any other descriptive information that was relevant to use of the habitat by waterbirds.

d. Past use: Although we relied heavily on interviews and published data for this information, it was often possible to detect evidence of past use of the wetland during site visits. Effort was made to assess the impact of this use on the site.

e. Present use: This information was also gathered by field survey and interview with landowners or other knowledgeable persons.

f. Current impacts: This portion of the survey was confined, for the most part, to the impact of current human activities on the area as waterbird habitat. Any observed relationship between the distribution or behavior of birds and ongoing human disturbance was noted.

g. Potential effects of dredge/fill activities: The major objective of this project was to provide information to be used in the evaluation of Section 404 permit applications. For this reason, effort was made to relate general information on dredge/fill impacts (page 19) to conditions within specific wetlands. In the absence of more thorough limnological and hydrological study of certain wetlands, it is clear that some conclusions in this portion of the study were somewhat subjective, and based largely on the educated opinion of the investigators.

III. Faunal Survey

a. Non-wetland birds: It was requested in the scope of work that we record a list of non-wetland birds observed during our site surveys. The line that divides a true wetland bird from other species is somewhat arbitrary. (see Species Accounts, page 22)

b. Terrestrial vertebrates: While a thorough survey of terrestrial vertebrates was not within the scope of work for this contract, we made note of any observations of these animals during field work. We were particularly interested in any information that could be derived on the distribution and behavior of potential predators and other animals that might be affecting the condition of waterbirds or their habitat.

c. Aquatic vertebrates: No attempt was made to undertake a thorough survey of aquatic vertebrates by standard collecting techniques. However, sightings of fishes and amphibians were noted. Particular emphasis was placed on those species that are potential prey or predators upon waterbirds.

d. Aquatic invertebrates: Observations of aquatic invertebrates were also incidental to bird studies, and are admittedly incomplete. Particularly dense concentrations of potential food organisms were noted because of the relevance of this resource to waterbird abundance and distribution. A thorough investigation of this group of organisms would have provided a more adequate foundation of human impact, but such a study was not within the scope of our contract.

IV. Waterbird Survey

a. Species list: self-explanatory

b. Species description: This was the primary emphasis on survey. For each waterbird species observed on a site survey, relevant data were noted in several general categories. Accurate counts were made wherever possible, and distribution within habitat was recorded onto maps and/or aerial photographs. Information on age class of birds observed was also noted. In the case of Koloa and migratory waterfowl, data on sex composition of observed populations was noted when possible. In an attempt to accurately define the type of habitat use (i.e. breeding, feeding, loafing), behavioral observations were recorded on all site visits. Realizing that conclusions based solely on these brief observations may be misleading, the condition of habitat to fill the various

needs of each species was evaluated as completely as possible. Recommendations for maintenance or improvement of habitat for species observed (and others that may use the area) were noted during site visits.

V. Recommendations for future research: In this section of field notes, suggestions for further study on return visits were noted. Recommendations for research beyond the scope of this project were also noted.

VI. Landowner interview: Where possible, landowners (or residents) familiar with the wetland sites were contacted during survey to avoid access problems and to accumulate additional relevant information in all categories discussed previously. Necessarily, observational data on waterbirds was noted with some reservations, due to the inconsistent competency of the observers. Many residents were shown pictures of birds (344) in order to confirm identifications. In many cases, reported sightings or other data on wetlands were confirmed by information received from different people, although some data were unsupported or even contradictory. These conflicts are indicated in appropriate discussions.

WETLANDS

"There is no single, correct, indisputable, ecologically sound definition for wetland because the gradation between totally dry and totally wet environments is continuous" (16). This statement provides some consolation to a reader wading through the abundance of published definitions. Yet, it does not help to explain on what foundation wetland inventories have been conducted in the past. One earlier wetland inventory defined 20 different wetland types, although broad categories included inland fresh water, inland saline, coastal fresh and coastal saline water (50). It is clear that categorization of wetlands involves the imposition of "arbitrary boundaries on natural ecosystems" (16).

In broad terms, wetlands include those areas where "water is the dominant factor determining the nature of soil development and the types of plant and animal communities living at the soil surface" (16). The most recent definition of wetlands that appears in published regulations of the Corps of Engineers is as follows:

> "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." (Federal Register, Vol. 42, No. 138, pg. 37128: July 19, 1977)

It may be more appropriate to define wetlands simply as "those land areas subject to periodic or permanent inundation during the growing season which causes the selection of a group or an association of plants that can tolerate the wet conditions" (522).

Wetland Values

The many and varied values of wetlands have been the subject of much recent debate and speculation, but most are well documented. Many of these values have been discovered in hindsight, after the destruction of a wetland has occurred. Each must be considered in the evaluation of projects that will alter the condition of a specific wetland area. A list of recognized wetland values includes, among others:

(1) performance of natural biological functions, including food chain production and habitat for a variety of aquatic and terrestrial species. Estuarine wetlands often provide important larval rearing grounds for a variety of marine species, including many commercially valuable fishes.

(2) sanctuaries for wildlife, including several species threatened with extinction.

particularly on the older islands. Yet, the amount of true estuarine habitat (zones of salt and fresh water mixing) where the streams or rivers meet the sea is limited. The largest estuarine areas (Pearl Harbor and Kaneohe Bay) are on Oahu, whils several smaller areas are found throughout the Islands, particularly on Kauai. Even in these areas, the amount of natural waterbird habitat is governed, in large part, by tidal patterns and stream flow.

Morphological differences from related species suggests that all waterbirds endemic to Hawaii were probably established in the Islands prior to the arrival of the first Polynesian canoes. Annual migrations of waterfowl and shorebirds to the Islands and beyond probably began before human settlement. How large a population of these species inhabited the natural wetlands cannot be determined.

It is nearly as difficult to determine what impact the Hawaiian culture had upon the wetlands and the waterbirds that inhabited them. All the native waterbirds were known by distinctive Hawaiian names, and some were the subject of legends. Waterbirds were among the species captured by early Hawaiians for food and for feathers (372). The presence of waterbirds in lowland areas, and the vulnerability of some species during flightless periods, probably resulted in severe exploitation. Yet, at the same time, early Hawaiians created additional habitat for waterbirds through their development of agriculture and construction of fishponds in coastal waters. It has been estimated that more than 25,000 acres of land were in taro production at a time when a reported 300,000 Hawaiians occupied the Islands. Over 200 fishponds lined the coastlines, or occupied the lowland stream drainages on at least five main islands (122). In the interest of fish production, these areas were kept clear of encroaching vegetation. Many of these fishponds provided waterbird habitat, although it is questionable whether they should be grouped together with true "wetlands". It seems certain that historically the greatest amount of waterbird habitat, both natural and man-created, was present in the Islands prior to the arrival of the first European sailing ship.

Within the 200 years since the arrival of Captain Cook in the Islands, most major natural wetlands of significance to waterbirds, and those created by early Hawaiians, have been eliminated or radically altered. Introduced plants, including mangrove and various weedy grasses, have encroached on fishponds and marshes, leaving only a fraction of the original habitat. Most of the original fishpond walls have disappeared or ponds have filled with silt during many years of disuse. By 1900, total acreage in taro production was estimated at 18,922 acres, yet by 1960 the figure was down to 510 acres (346). A shorter history, but also significant story of waterbird habitat loss, was illustrated by the rice industry in Hawaii. In the forty years after the first Island rice crop was planted in 1860, total acreage in rice rose to more than 16,000. Yet, with competition from rice production on the West Coast and in the Orient, and probably as a result of crop depredation by introduced birds, the rice industry in Hawaii had ceased to exist by 1963 (346). The expansion of other forms of agriculture (i.e. sugar cane, pineapple)led to the elimination of some waterbird habitat, but at the same time resulted in the creation of new habitat in irrigation reservoirs and in cane waste silting basins. Unfortunately, the condition of this artificial waterbird habitat is subject to the demands for water by these industries, so these areas are managed without consideration of waterbird habitat requirements.

(3) research areas for the study of ecological processes, educational opportunities for the study of natural history.

(4) protection of natural drainage patterns, including levels of sedimentation and salinity distribution.

(5) protection of adjacent lands from wave action, erosion, and storm damage.

(6) storage of storm and flood waters.

(7) accumulation of nutrients.

(8) recharge of ground water.

(9) retention of surface water for agricultural use.

(10) production of cash crops, including various plants and commercially valuable aquatic species (i.e. aquaculture).

(11) recreational opportunity (fishing, hunting, boating, nature appreciation, etc.).

(12) aesthetics and visual appreciation (open space and natural beauty).

Wetlands in the Continental United States

Although there are some problems in comparing the results of wetland inventories due to differences in classification, an overall look at historical data provides an alarming picture of the deterioration of wetlands in the United States. It is estimated that over 35% (45 million acres) of the original natural wetlands in the continental U.S. (127 million acres) have been "reclaimed" (i.e. eliminated as waterbird habitat) by clearing, drainage and flood control projects (50). Nearly half of the remaining wetlands are classified as seasonally flooded basins or flats and as wooded swamps.

The U. S. Fish and Wildlife Service estimates that over 30% of the wetland habitat left in the continental U. S. is of moderate or high value to waterfowl (50). This includes both nesting and wintering habitat. The U. S. Fish and Wildlife Service has established refuges within the continental U. S. to provide secure habitat for waterfowl and other wetland species, and to provide recreational and educational opportunity. Much waterbird habitat, both on and off refuges, has been improved through the impoundment of surface water, dredging or blasting of open water areas, and planting of waterfowl foods.

Wetlands in Hawaii

Porous volcanic soils, and the relative lack of expansive flood plains, limited the amount of wetland habitat available to waterbirds in pre-Hawaiian times. Natural wetlands in the Islands include high elevation forested bogs, streams and their tributaries, small high elevation natural lakes, estuaries, and a few marsh areas. Numerous perennial streams and rivers reach the sea,

The most recent, but also perhaps the most severe, adverse impact on natural and man-created wetlands, has been the urbanization of lowland areas, particularly on the island of Oahu. Many of the large wetland areas that provided waterbird nabitat historically were not included in this survey since they no longer exist. For example, a description of wetlands in the Waikiki area in 1824 reads "The whole distance to the village of Whyteete (Waikiki) is taken up with innumerable artificial fishponds extending a mile inland from the shore....The ponds are several hundred in number and are the resort of wild ducks and other waterfowl." (in 122). In some areas, the elimination of wetlands was not total, but the alteration of feeding and nesting areas, and the continuing human disturbance, have rendered the habitat nearly worthless to waterbirds. Perhaps the greatest reason for concern when evaluating the current condition of wetlands in the State is the lack of long-term security for several areas of importance to waterbirds. Until the establishment of the first U. S. Fish and Wildlife Service wetland refuge in the State in 1972 at Hanalei, Kauai, not one wetland of prime importance to waterbirds was assured future protection and proper habitat management. Although five Federal refuges and one State refuge have now been established, and several other State and Federal refuge projects are underway, several remaining areas of prime importance to waterbirds are still threatened.

Natural and man-related wetlands of significance to waterbirds in the State of Hawaii can be roughly categorized. Use of these habitats varies among different waterbird species, so no attempt is made to rank them in terms of their importance.

Natural habitats:

(1) rocky and sandy shorelines

(2) high elevation bogs

(3) swampy forested lands

(4) streams and tributaries

(5) large rivers

(6) inland freshwater marshland

(7) coastal brackish marsh

(8) estuarine mudflats

(9) periodically flooded grassland

Man-related habitats:

(1) taro and watercress fields

(2) drainage and irrigation ditches

(3) reservoirs and other water storage areas

Man-related habitats (cont.):

(4) sewage ponds

(5) cane waste settling basins

(6) artificially created waterbird habitats

(7) coastal and inland fishponds and other aquaculture facilities

(8) ephemerally flooded pastures

WATERBIRDS

The term "waterbird" is almost as difficult to define as the term "wetland". For the purposes of this study, consideration is confined to species that are dependent upon wetland habitat for a major portion of their ecological requirements. Although the range of some waterbird species includes both wetland and terrestrial habitats (i.e. Golden Plover, Cattle Egret), they will be treated in this report when they are found within wetlands.

In view of the extreme variation in conditions in wetlands, it is not surprising that a wide variety of waterbirds have evolved to exploit the resource available. Typically, wetlands provide abundant food both within the water and in the bottom substrate, yet that food may only be temporarily available (i.e. seasonal, tidal, etc.). Seasonal abundance of food is probably the primary reason for the widespread tendency of many waterbirds to migrate annually to wintering areas. The most obvious differences between various waterbirds involve mechanisms for gathering food, particularly leg and bill structure. A rich but widely diverse food resource in a wetland can be successfully exploited by a wide variety of bird species that subdivide the habitat ecologically. Although different species may feed in the same substrate, they may further divide the resources by probing or diving to different depths and seeking different organisms or plant foods. Behavioral adaptations to withstand crowding will allow many birds, often of different species, to share limited habitat where food may be temporarily abundant.

The term "waterfowl" generally is restricted to ducks, geese and swans of the family Anatidae, although it is often extended broadly to include other non-wading aquatic species such as coots, gallinules and grebes. There are nearly 150 species in the family Anatidae. Many are found in North America, where they inhabit a variety of fresh, brackish and salt water wetlands. Most of these birds are migratory to some degree, typically moving south into lower states and Mexico during winter months. Banding records have established that most migrating waterfowl in North America follow four relatively well-defined "flyways", roughly in a north-south direction. Morphological differences in waterfowl typically involve adaptations relating to feeding ecology, although there are numerous differences in nesting habits, breeding behavior and other aspects of their biology as well.

Numerous species that feed in wetlands while walking on the bottom range in size from small shorebirds (sandpipers, plovers, turnstones), to a wide assemblage of wading species (stilts, avocets, herons, egrets, bitterns, etc.). Many families are represented in this diverse wetland avifauna, most of which are differentiated by adaptations related to capture of food. The small shorebird species, as a rule, are more prone to long annual migrations than are the larger wading species. In addition, a wide variety of "marine birds" or "seabirds" seek food and often nesting sites in wetland habitat. Most seabirds find the bulk of their food in marine environments, but some will share wetlands,

particularly brackish estuaries, with those shorebirds and waterbirds discussed above. Some seabirds will migrate long distances annually while others may occur irregularly as stragglers several thousand miles from their nesting grounds.

Waterbirds of Hawaii

The endemic waterbird avifauna of Hawaii is not large. Only six extant species or subspecies of "waterbirds" are unique to the Islands (see Species Accounts, page 22). These birds represent three distinct avian families (Anatidae, Rallidae, Recurvirostridae). An additional waterbird family (Ardeidae) is represented by one resident native species that is not endemic to the Islands. One species of Anatidae, Hawaiian Goose or Nene (Branta sandvicensis), is not truly a waterbird. It has forsaken the wetland habitat of its ancestors and adapted to high elevation lava flows and grassland, devoid of standing water. Although Nene occasionally visit reservoirs and other wetland habitats, they can subsist on water derived solely from dew or from plant foods. Another endemic member of the Anatidae family, Laysan Duck (Anas laysanensis), is found only on Laysan Island, in the Northwestern Hawaiian Islands. This species has the most restricted range of any waterfowl in the world.

In addition to the resident native waterbirds, several species of migratory shorebirds and waterfowl visit the Hawaiian archipelago each year, and most return to their arctic or subarctic breeding grounds during the summer months (page 39). Only a small percentage of the shorebirds and waterfowl species that have been reported in the Islands are regular visitors in large numbers. Migratory seabirds that nest outside the Islands appear occasionally in Hawaii's wetlands in very low numbers, while at least two resident breeding species (Great Frigatebird, Black Noddy) regularly enter the coastal wetland areas in search of food.

Status of Waterbirds in Hawaii

Historically, the construction of fish ponds and planting of taro by early Hawaiians certainly added to the natural waterbird habitat in the Islands, but it is not known to what extent this was counteracted by the harvest of these birds for food and feathers. Introduced rats, pigs and dogs surely must have had an adverse impact on these wetland species. The list of predators grew substantially in the last 200 years, as did the abundance and distribution of those species already established in the Islands at an early date. The mongoose (Herpestes auropunctatus), introduced in 1883 to control rats in sugar cane fields, has been implicated as a serious predator on most of the native waterbirds (350). Breeding success of waterbirds in several wetlands in the State is dependent on the inaccessibility of nest sites to this and other predators.

Many native and migratory wetland birds were protected by law as early as 1881, largely because they were believed to play a role in the control of army worms. Migratory waterfowl (called "nor'west ducks") were said to occupy still bays and fishponds by the thousands. Hunting bag limits for ducks were set as high as 25 birds per day in the early 20th century. In 1928, the Chief Territorial Warden (H. L. Kelley) recommended that all duck hunting be stopped because "migratory ducks have become so scarce that one seldom hears them even mentioned by the hunters." Yet, in spite of repeated warnings by some concerned biologists,

duck hunting did not stop until 1939. No wetland birds have been legally hunted since that date, but a small number of birds are probably killed illegally in some wetlands.

Several other factors have had an adverse impact on native and migratory waterbird populations. Botulism in Hawaiian waterfowl has been recorded on at least three occasions within the last 25 years (354). A serious outbreak of this disease in a single habitat could kill as many as half the total population of an endemic species. Numbers of some species are low enough that resultant inbreeding may weaken the population against the attack of other diseases as well. Uncontrolled increase in water levels in some habitats has led to the flooding of nest sites and feeding areas, while draining of habitat has rendered nesting islands accessible to predators and dried formerly valuable feeding areas. Channelization of streams has eliminated some food resources while various activities associated with agriculture (burning of cane fields, application of insecticides, poisoning of algae in ditches) have all been suggested as factors contributing to the declining quality of remaining waterbird habitat (346).

Efforts to protect diminishing waterbirds began with enforcement of hunting regulations before World War II. With Federal assistance, State biologists (Division of Fish and Game) began an investigation of migratory waterfowl after the war and have continued regular censusing activities since that time. The initial emphasis was on migratory species, based on the belief that those species might sustain a recreational hunting program. Emphasis shifted to a broader program with a more protective approach, beginning with the establishment of the first State wetland sanctuary (Kanaha Pond, Maui) in 1952. Active research into waterbird biology began in 1962 with an intensive research investigation of the Hawaiian Duck or Koloa (406). Until recently, little additional field research has been undertaken, although some efforts at predator control, captive rearing and movement studies have been initiated. Current research by State biologists has expanded to detailed investigations of breeding biology and habitat requirements of native waterbirds.

Federal biologists became directly involved in Hawaiian waterbird conservation in 1964, with studies at Kanaha Pond, Maui. Five endemic waterbirds were listed as "endangered" in the Endangered Species Conservation Act of 1966 and they are all still listed at this time. The U. S. Fish and Wildlife Service (USF&WS), in cooperation with State biologists (HDF&G), published an assessment of wetland habitats for endangered waterbirds in 1970 (343). The USF&WS began an intensive effort to acquire important wetland areas and to manage these areas as Federal refuges. To date, five areas on three islands are in Federal refuge status and at least two more areas are close to acquisition. State and Federal biologists have also cooperated with representatives of military installations to improve wetland management programs on military lands.

The Hawaiian Waterbird Recovery Plan Team was appointed by the USF&WS in 1975 to prepare an action plan to restore populations of three endemic waterbirds (Stilt, Coot, Gallinule). Many of the recommendations suggested in the Second Draft Plan (346), particularly those relating to habitat management, extend beyond the requirements of these three species and will have broad implications for all species occupying wetland environments. Included in this Draft Plan are evaluations of numerous known waterbird habitats in the State, many of which are on the list of sites visited on this survey.

EFFECTS OF DREDGING AND FILLING ON WATERBIRD HABITAT

Accelerating loss of wetland areas, coupled with increasing recognition of the many and varied values of wetlands, has led to numerous forms of legislation to protect and conserve wetland resources. Section 404 of the Federal Water Pollution Control Act (FWPCA) is administered on a permit system by the Corps of Engineers. It is among the most significant recent controls that regulate activities in wetlands. This regulation specifically controls the discharge of dredged and fill material into wetlands. The impact of this activity has been a major cause of wetland deterioration in the United States. The impacts of dredge and fill operations on wetland avifauna can be rapid and obvious, but they may also be indirect, gradual and subtle.

The most obvious and complete result of deposition of dredged or fill materials in a wetland is the total elimination of habitat by raising the bottom above the water level. Numerous wetlands in Hawaii, particularly in lowlands on the leeward slopes of Oahu's Koolau range, have been drained and filled with soil to create urban areas that accomodate rapidly increasing population. Many fishponds have been eliminated by the same process. In other cases, the accumulation of silt and consequent filling of marshy areas has been a gradual, but natural, process of ecological succession. With filling of wetland habitat, the encroachment of aggressive weedy vegetation is accelerated and the value of the area as waterbird habitat diminishes rapidly.

In the evaluation of potential impacts of dredge and fill operations in a wetland, the environmental parameters that are critical to the condition of the habitat include, among others, water depth, water level fluctuation, substrate type and condition, water quality, turbidity, patterns of water flow, and current and wave patterns. These parameters do not operate independently, nor are the effects of changes in one or more parameters exactly the same when different wetland habitats are compared. To a certain extent, each wetland is unique, and scientific studies can aid in determination of specific characteristics and environmental parameters that would be affected by dredging and filling activities.

Water depth in a wetland will determine, in large part, the diversity and distribution of vegetation. Submergent plants will not grow well in deep water because of lack of light, although light penetration will be affected by other factors as well. Water depth will also affect the distribution and density of floating-leaved and emergent plants. Competitive ability of some plant species will vary with depth. The type, density and distribution of vegetation and of associated invertebrates, will play an important role in determining what waterbird species will occupy the site, and whether or not a particular site will be suitable for feeding or nesting, or both. Shallow water habitats will favor wading or probing birds, while dabbling and diving ducks may occupy deeper waters, and exploit different food sources. Obviously the amount and location of deposited fill materials will have a direct bearing on long-term changes in water depth.

Often more critical than the water depth itself is the frequency and degree of water level fluctuation. Dredging or filling operations may change drainage patterns and result in irregular or unpredictable water level fluctuations. Filling may raise the bottom above the water level, but the impact of this can be varied. Dewatering (exposure of bottom substrate) is necessary for the germination of some plants, but will result in the destruction of others. Many aggressive emergent plants, such as cattails, may be encouraged by dewatering or frequent fluctuations in water level, but may be damaged or killed by prolonged high water (434). On the other hand, submergent or floating-leaved plants (many of which are important waterbird food sources) may be less tolerant of water level fluctuations. Periodic drying of some wetland areas, depending on types of vegetation, can be used to remove some undesirable plants and to increase the fertility of the soil and permit aeration. Dewatering may also permit elimination of some aquatic species that may decrease the value of the site for waterbirds (i.e. tilapia), but it must be weighed against the losses of other desirable aquatic fauna. In sum, control of water level fluctuation can be an important tool in wetland management, but to be consistently effective, a thorough knowledge of wetland ecology is valuable.

The type and condition of wetland substrate will also play a role in determining the quality of a wetland area as waterbird habitat. The bottom flora and fauna are part of the food chains of a marsh and are vulnerable to disturbance as a result of dredging and filling. Plants rooted in the bottom may be disturbed by fill, or simply prevented from receiving necessary light as a result of increased silt in the water. Deposition of dredged materials may often replace a fertile bottom soil with a comparatively sterile gravel or sand bottom, far less capable of supporting plant or animal growth.

Water quality in a wetland can vary almost undetectably, but the impact on wildlife can be far reaching. There may be natural variation with time of day or season. Processes of water movement, evapotranspiration, plant uptake and release of gases and microbial activity all play a role in determining quantities of oxygen, carbon dioxide, and nutrients, and influence measurements of total alkalinity and pH (434). If dredging or filling operations influence these parameters significantly, the effects on the wetland ecosystem can be severe. Deposition of some fill materials, particularly those associated with sanitary landfills, may introduce a variety of toxic substances and gases. Leaching from landfills may occur for many years after deposition.

Turbidity levels in a wetland will vary naturally as well, depending on erosion, runoff, stormwater drainage patterns, and levels of primary production. In itself, increased turbidity will inhibit photosynthesis in submerged plants. In a wetland with relatively stable water levels, these plants may play an important role as food for wildlife, and as shelter for a large variety of aquatic invertebrates and fish. Increased turbidity, particularly in wetlands with little water movement, may be the result of bottom feeding or nesting activities of fishes (i.e. carp, tilapia). Depending on substrate conditions, turbidity as a result of dredging may be short-lived and the effects on wildlife may be only temporary. However, the level of turbidity and its impact on wetland ecology will depend on a variety of interrelated factors that include water levels, current patterns, drainage, bottom nutrient levels, primary productivity and tolerance of aquatic organisms.

Patterns of water flow in a wetland may determine how large an area will be affected by dredging and filling, and for how long a time the effects will be felt. Alteration of flow as a result of water diversion may lead to changes in salinity gradients, and affect the distribution of oxygen and nutrients. The rate of accumulation of organic material will be affected by currents in a wetland. Increased fertility of bottom soil, can, in turn, increase the rate at which encroaching vegetation takes over a pond or a marsh, resulting eventually in diminished waterfowl values.

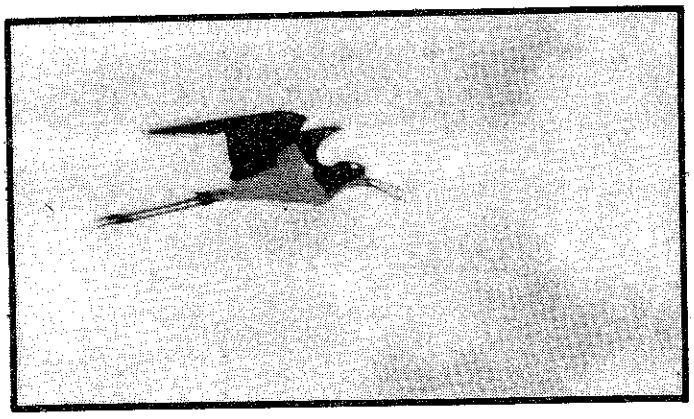
The interrelated factors that together determine the condition of a wetland as waterbird habitat each must be considered in evaluating the potential impacts of change in that system. Good feeding or nesting habitat for one bird species may be totally undesirable for another. A thorough understanding of the habitat requirements of each species is necessary in assessing whether or not dredging or filling operations will have a long term impact on wildlife use of an area. Shorebirds and smaller wading species prefer shallow waters and fertile bottom soil. Many of these species are opportunistic and will probe for food in saline or fresh water habitat. Although shallow water is critical for feeding in these species, it provides little protection against predation, particularly during nesting. On the other hand, coots, gallinule and a variety of duck species in Hawaii prefer deeper water as a rule, but rely upon available vegetation for cover, food, and nesting habitat.

Few habitats in Hawaii provide all the necessary requirements for more than one species of waterbird, but it is possible to increase the year around occupation of habitat by waterbirds through manipulation of conditions. Dredging and filling operations can play an integral role in the improvement of habitat and in the creation of new habitat for waterbirds. Impoundment of water requires fill for dikes or the removal of accumulated silt in flood plain areas. Water diversion structures are useful in manipulating habitat, whether the water source is a well or a stream drainage. Some of the prime waterbird habitat in the State is provided by impounding water for taro production. Dredging and filling may also be important in the clearing of overgrown vegetation, reestablishment of water flow, creation of moats to restrict predator access and the construction of artificial nesting islets within large bodies of open water. All of these activities have contributed to the improvement of waterbird habitat in Hawaii.

SPECIES ACCOUNTS

This section includes synopses of pertinent biological data and management information on resident waterbirds. More general information and species lists are provided for non-resident (migratory) waterbirds, seabirds and other native or exotic bird species, some of which may be observed within Hawaii's wetlands. The reader is referred to more extensive treatment of these species in the publications listed with the Bibliography (page 64).

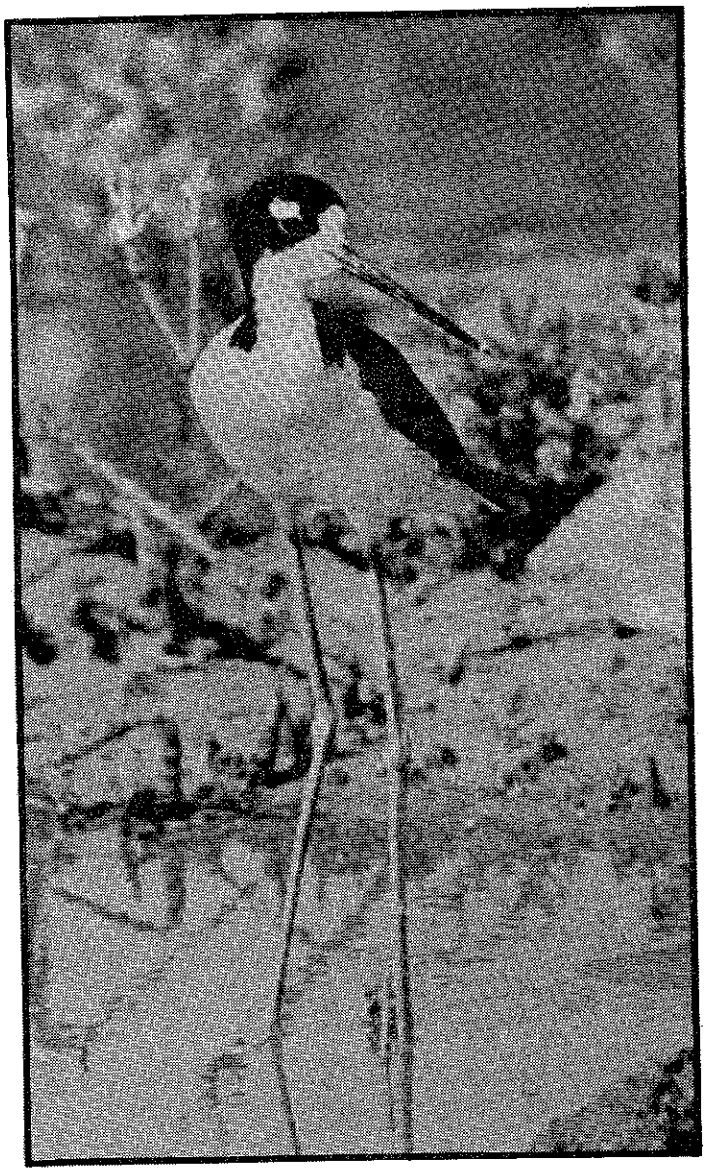
Species are identified by the following names: the scientifically accepted common name, other commonly used names, Hawaiian names, and scientific names.



Hawaiian Stilt

ae'o

Himantopus mexicanus knudseni



NAMES: Hawaiian Stilt (Black-necked Stilt, Hawaiian Black-necked Stilt)
ae'o, kukuluae'o ("one standing high")
Himantopus mexicanus knudseni
(formerly Himantopus himantopus knudseni)

DESCRIPTION: Believed to be derived from North American Black-necked Stilt, although morphologically distinct. 16 inches long; sexes similar; black above and white below, with white forehead. Straight, black bill and long, pink legs. Downy chicks are tan, blotched with black, later turning gray. Older juveniles resemble parents, although back feathers are browner, legs are paler in color, and tarsometarsus is thicker at proximal end. Eggs are olive-brown with dark brown or black speckling or blotching over entire surface.

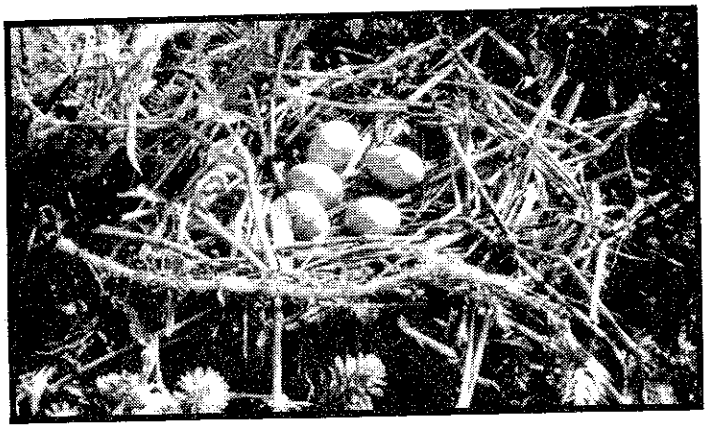
BREEDING BIOLOGY: Generally nests in or close to fresh or brackish water ponds, mudflats and marshlands. Nesting season extends from late March through July, although most breeding activity is in May-June. Nest is usually a scrape in the ground, but may be a shallow bowl of vegetation and other debris. Nest is lined with pebbles, twigs, mollusc shells and debris. Stilt will build nests on mud, mounds built by the birds in taro patches, abandoned coot nests, and on top of limestone mounds. Breeding success is greatest where nests are built on islets surrounded by water, protected from predation. Nests are typically 75-100' apart. "False" nests or "symbolic" nests may be built close to actual nest. Typical clutch has 4 eggs, occasionally 3; incubated approximately 24 days. Both parents share in incubation duties. Nests are vigorously defended by adults. May engage in "distraction display" when approached by possible predator. Chicks leave the nest within 24 hours after hatching, yet are brooded by parents for several days. Young capable of limited flight in approximately 30 days.

FEEDING ECOLOGY: Stilt seek food in a wide variety of lowland natural and man-altered habitats, including mudflats, settling basins, marshes, reservoirs, taro fields, fish ponds, drainage ditches and flooded pastures. Adapted to feeding in ephemeral sites. Will crowd, often with various shorebird species, when food is localized and temporarily abundant. Studies of gut samples in local race are lacking, but known to take polychaete worms, crabs, aquatic insects and various fishes (mullet, tilapia, mosquito fish). Probably opportunistic, consuming a wide variety of other aquatic organisms. Data on North American race confirms feeding on several types of insects (Heteroptera, Coleoptera, Dystera, Trichoptera, Odonata) as well as molluscs, fish and some vegetable matter.

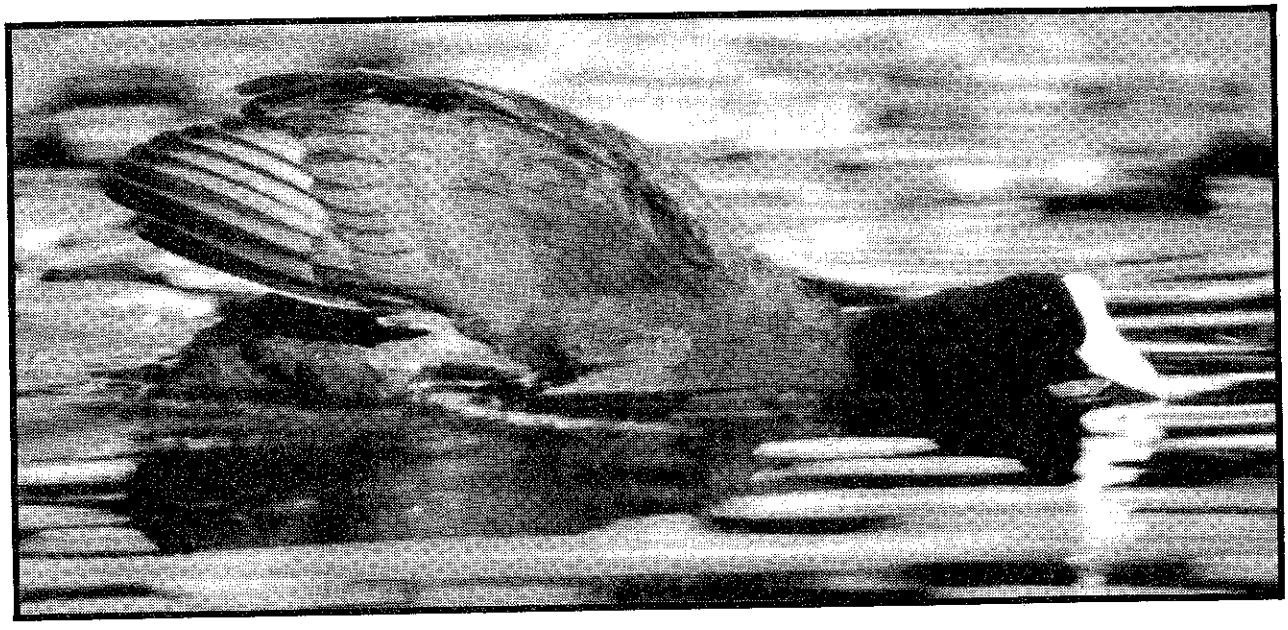
MORTALITY: Subject to predation (particularly eggs and young) by mongoose, dogs, cats, rats, and possibly by herons, owls and large fish. Predation may be particularly severe where nesting sites are not isolated by water. Nests are also destroyed by changing water levels, either through flooding or by increased accessibility to predators. Human disturbance causes incubating or brooding birds to leave nests, exposing eggs and young to high solar radiation and increased predation. Feeding birds appear more tolerant of nearby human activity than are nesting birds. May also be susceptible to changes in water quality, disease and parasites.

STATUS AND DISTRIBUTION: Stilt are still present on all islands for which there are historical records (Niihau, Kauai, Oahu, Molokai, Maui, Hawaii). Currently

classified as "endangered" by both State and Federal laws. Count data suggest regular annual movement between Kauai and Niihau. Some movement between other islands has been confirmed, but extent of movement is unknown. Stilt were hunted legally until 1939. Population in 1944 was estimated at 200 birds (382). Significantly higher counts soon after this estimate probably reflect differences in count coverage, as well as reduced disturbance of birds. Annual HDF&G/USF&WS counts over the last 20 years show unexplained fluctuations, sometimes exceeding 200% (page 116). Maui and Oahu, on the average, account for approximately 80% of stilt in Hawaii. Primary nesting and feeding areas on these islands include Kanaha Pond, Kealia Pond, Pearl Harbor and Kaneohe Marine Corps Air Station. Numbers on Molokai and Hawaii have been relatively stable (less than 30 each). Population on Kauai appears to be increasing, yet this may also reflect increased count coverage in recent years. The total population for the Islands is estimated at 1,500 birds (346).



Hawaiian Coot
'alae ke'o ke'o
Fulica americana alai



NAMES: Hawaiian Coot (American Coot, mudhen)
'alae ke'o ke'o, 'alae-kea, 'alae-awi (red-shielded variety)
Fulica americana alai

DESCRIPTION: Believed to be derived from the American Coot (Fulica americana). Hawaiian subspecies is smaller in size but has a larger frontal shield and slight differences in plumage. 14 inches long; sexes similar; solid grayish-black except for white patches under tail; white bill and frontal shield. Small percentage of Hawaiian birds have deep red lobe at top of frontal shield and black marking on tip of bill, similar to mainland race. Feet are lobed. Downy young are black with reddish color on head, with red bill and frontal shield. Juvenile birds are brownish gray; frontal shield yellow-brown, turning to white. Eggs are light tan or cream, heavily spotted brown or black.

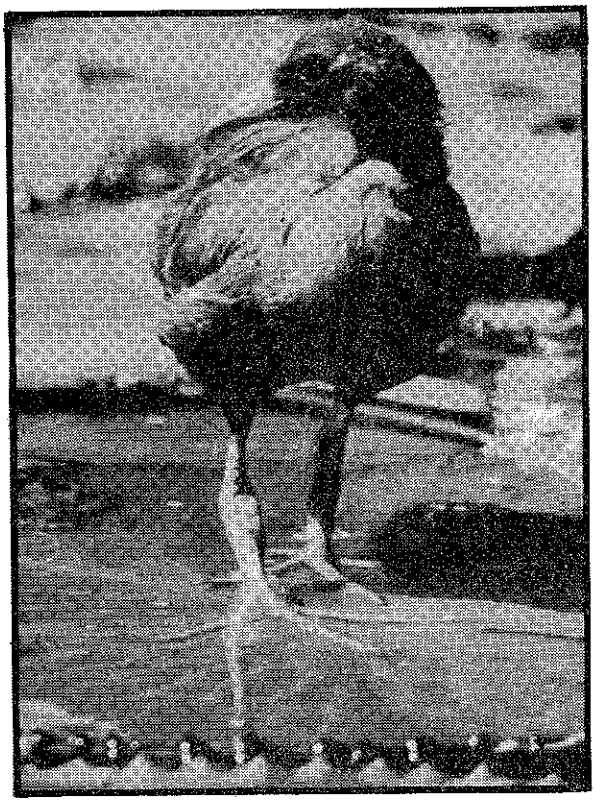
BREEDING BIOLOGY: Prefers open fresh and brackish water ponds, nesting along fringes or in small open areas in marshy vegetation. Nesting season concentrated March to September, although active nests and young chicks observed all months of year. Builds large floating nests of aquatic vegetation (cattails, bulrush, grasses, pickleweed). Composition of nests generally reflect types of nearby vegetation. Nests may have well-defined walkways onto the rim. Adults will continue to add new material during incubation. Clutch size varies from 3-10 eggs; average clutch may also vary (4-6 eggs) depending on nesting area. Additional "false" nests, often used as resting platforms, may be constructed close to the actual nest. Distance between nests is highly variable, but typically less than 100'. Incubation period poorly known, but limited data indicates 23-27 days (American Coot 21-22 days). Both parents share in incubation and territory defense. Chicks may swim from the nest soon after hatching, yet remain close to parents through exchange of vocalizations. Immature birds may be seen with parents several weeks after hatching.

FEEDING ECOLOGY: Typically feeds close to nesting sites. Coots may gather in large concentrations (1,000 or more) at large reservoirs or other areas where food is available, often long distances from nesting habitat. Prefers fresh or brackish water sites, surrounded by dense vegetation. Data on food taken by Hawaiian race is limited, but food probably includes seeds and green parts of aquatic plants, crustaceans, worms, freshwater snails, aquatic insects, tadpoles and small fish. Coots typically feed on surface, but will dive regularly in habitat with suitable submergent vegetation or animal food below surface. May eat some wetland crops, particularly young taro.

MORTALITY: Fluctuations in water levels can cause nest destruction and consequent egg loss. Predators include mongoose, cats, dogs and possibly rats, largemouth bass, and herons. Illegal killing occurs, particularly in taro fields where many farmers consider these birds a nuisance. Poisoning of algae in irrigation ditches destroys a potential food source. Coot losses have been documented in botulism outbreaks both in Hawaii and on the mainland. Some birds are killed by cars on roads and as a result of collision with high tension wires or towers. Coots are easily disturbed from their nests or from feeding areas by humans, yet will adapt somewhat to regular, non-threatening presence of humans.

STATUS AND DISTRIBUTION: Found on all larger, inhabited islands except Lanai. Species was hunted as a game bird until 1939. The species is currently listed as "endangered" by State and Federal laws. Today, the estimated population is

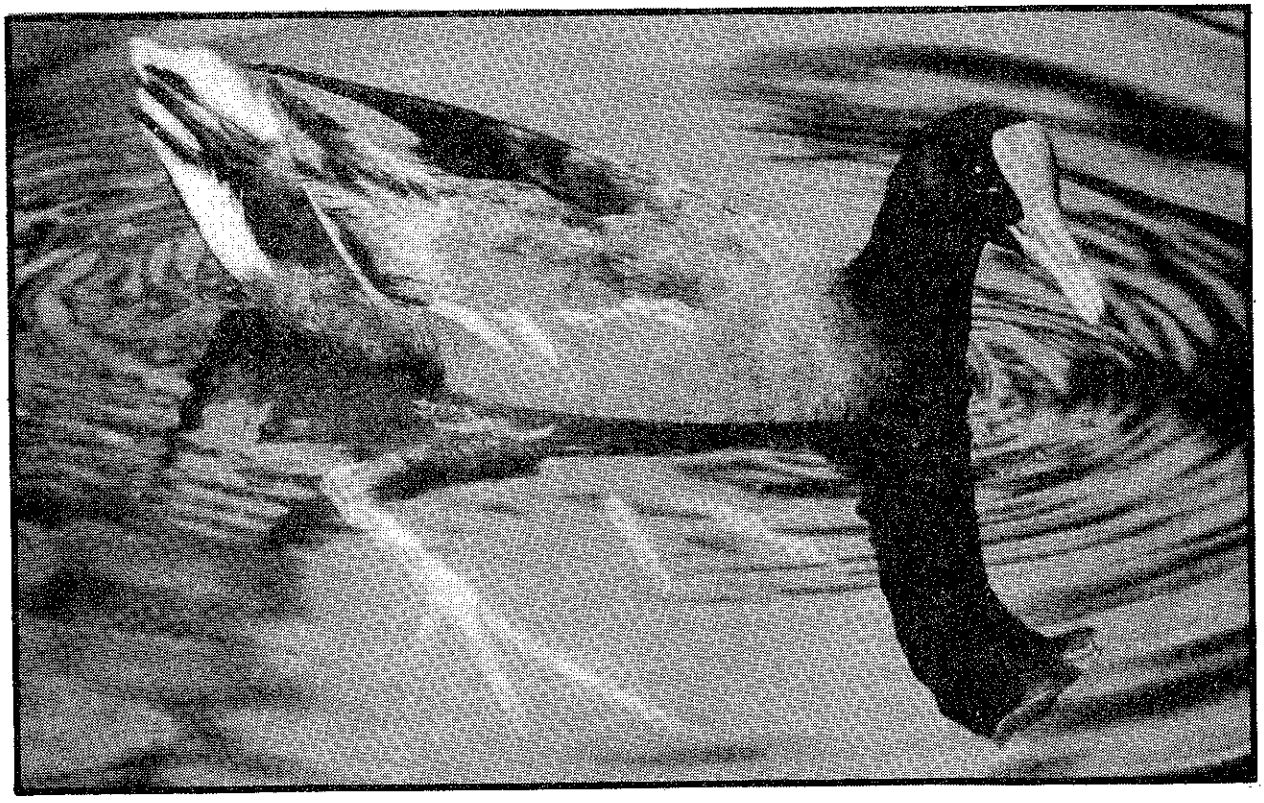
2,500 birds, based on a January, 1977, statewide count of 2,330 birds (346). Past records have intermittently shown abnormally large concentrations of birds in single habitats. Speculation that these concentrations might represent a temporary influx of mainland birds is unsupported by collection of individuals for verification. Possibly these abnormal concentrations result from interisland movement. Count records over last 20 years illustrate radical fluctuations from year to year, and probably do not reflect actual population changes (see pg.117). Largest numbers have always been found on Oahu, Maui and Kauai. Coots that winter on Kauai are believed to breed in large numbers on Niihau, although drought conditions in Niihau nesting habitat may cause coots to remain on Kauai throughout the summer months.



Hawaiian Gallinule

'alae 'ula

Gallinula chloropus sandvicensis



NAMES: Hawaiian Gallinule (Common Gallinule, mudhen, moor hen)
'alae, 'alae 'ula, 'alae-huapi
Gallinula chloropus sandvicensis

DESCRIPTION: Believed to be a subspecies of the Common Gallinule (*Gallinula chloropus chloropus*) of North America. 13 inches long; sexes similar; bluish-black with white feathers under tail and on flanks. Bill and frontal shield are red, except for yellow tip. Feet and legs are yellowish-green with reddish patches near body. Downy young are black with red bill and frontal shield. Juvenile birds are grayish-brown with a pale yellow or brown bill. Eggs are cream colored with brown or black spotting.

BREEDING BIOLOGY: Frequents freshwater ponds, marshes, streams and various man-made habitats (ditches, reservoirs, taro patches). Nesting recorded in all months of year, concentrated during March-August. Generally more secretive than other waterbirds, taking refuge in dense vegetation when approached. Walks across floating vegetation in search of food and cover. Nests are inconspicuous within emergent vegetation (cattails, bulrush, tall grasses) or within taro fields. Nearby vegetation is folded into platform nest. Clutches of 6-13 eggs recorded, although large clutches may represent eggs laid by two or more females. Incubation period of the Hawaiian Gallinule is unknown (Common Gallinule 20-24 days). Chicks swim away from the nest very soon after hatching but remain close to parents for several weeks. Young chicks are fed by adult birds. Field observations suggest that some pairs may nest more than twice in one year.

FEEDING ECOLOGY: Little precise information available on feeding habits of Hawaiian Gallinule, although believed to consume algae, seeds, grasses, aquatic insects, and a variety of molluscs. Food of Common Gallinule includes dragonfly and mayfly nymphs, other insects, seeds and small aquatic snails. Hawaiian race is probably opportunistic so that diet varies with habitat. Also will eat young shoots and tops of taro plants.

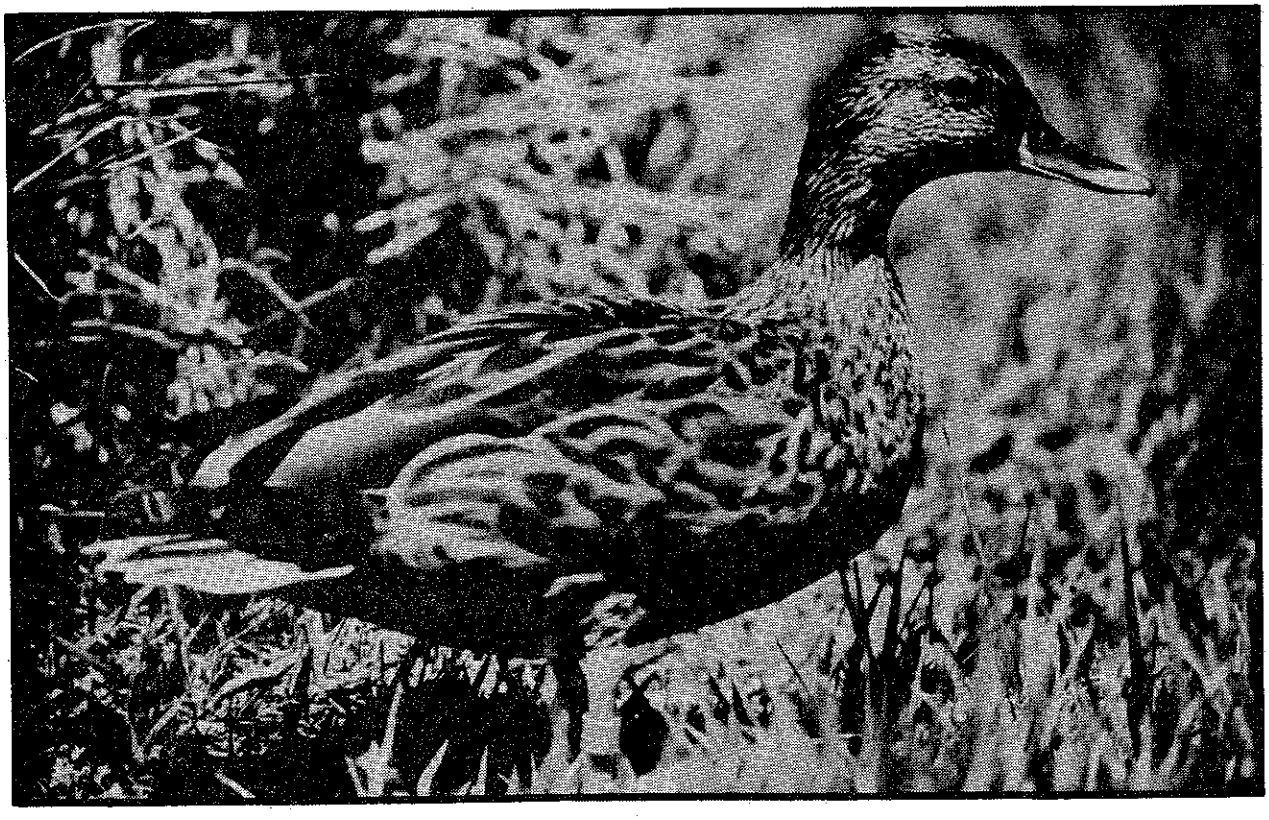
MORTALITY: Rapidly increasing water levels will cause egg mortality in nests, although adults may add vegetation to nest to avoid flooding. Predators include mongoose, cats and dogs, and possibly bass and herons. Illegal killing may occur in taro fields, where birds are sometimes considered pests, but is probably minimal elsewhere. Disturbance of habitat by human activity will cause birds to leave their nests, although they may accomodate to repetitive, non-threatening disturbance (i.e. taro farmers on Hanalei National Wildlife Refuge).

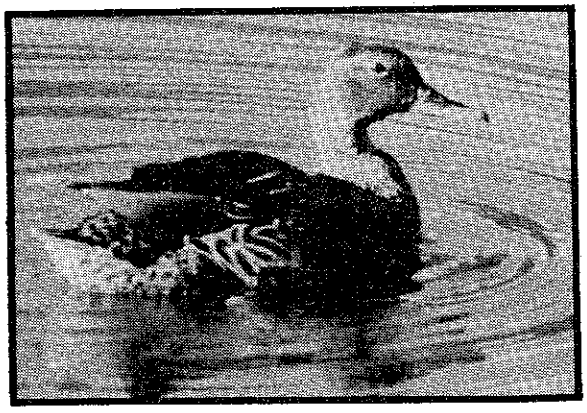
STATUS AND DISTRIBUTION: The gallinule figured prominently in legends of early Hawaiians. It was reported as "common in swampy taro patches throughout Hawaii, Oahu, Maui and Kauai" in the late 1800's (418). In 1947, the condition of the species was reported as precarious on Maui, Molokai and Oahu. It is apparently now absent on Maui, Molokai and Hawaii. An attempt to reestablish the species on Maui by releasing birds has apparently failed, although there appears to be unoccupied suitable habitat available. This species is listed by State and Federal laws as "endangered". The largest recorded population is now on Kauai, although count records of this inconspicuous species probably bear little relationship to actual population. The current estimate of 750 birds (346) is purely speculative and it is clear that better census methods are required to evaluate population condition.

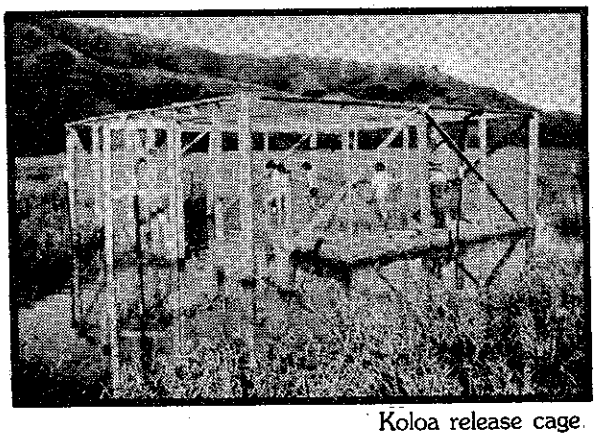
Hawaiian Duck

koloa maoli

Anas wyvilliana







Koloa release cage.

NAMES: Hawaiian Duck
koloa, koloa maoli ("native duck")
Anas wyvilliana

DESCRIPTION: Similar to and probably derived from Mallard (Anas platyrhynchos). 19-20 inches, males darker brown than females; most similar to Mallard drake in first nuptial plumage. Hens are streaked brown and smaller than males. Both sexes have blue wing speculum. Downy young are brownish-yellow. Eggs are generally white, with some buff or light tan variations.

BREEDING BIOLOGY: Inhabits taro patches, reservoirs, drainage ditches, flooded fields, streams, river valleys and densely wooded habitat. Species more widely distributed than other endemic waterbirds, from sea level to over 4,000'. Nests on the ground, generally near water. May breed year around, but concentrated December-May. Lays 2-10 eggs, with clutch averaging approximately 8 eggs. Young remain with adult pair for several weeks after hatching. Birds may breed successfully in their first year.

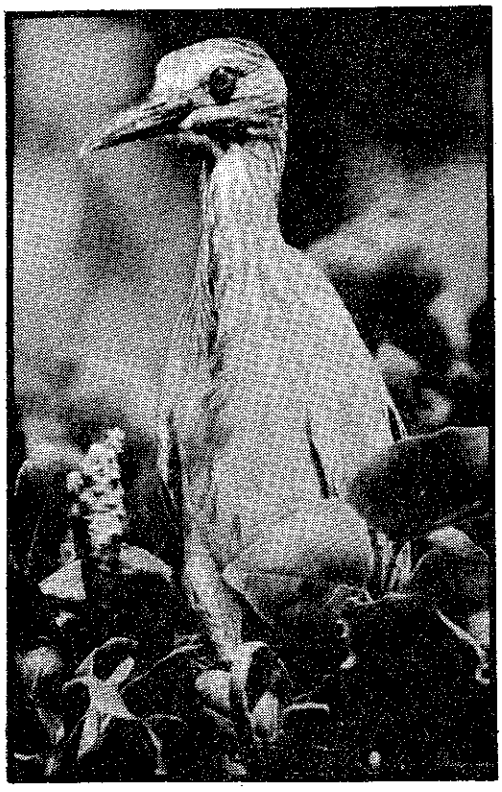
FEEDING ECOLOGY: Known to take a wide variety of foods including snails, earthworms, dragonflies, algae and leaf parts and seeds from a variety of wetland plants (406). Frequently seen feeding in taro fields. Uniform water levels provide constant food supply, but birds may seek out freshly drained reservoirs for temporarily abundant food. Koloa will disperse widely when heavy rains create temporary feeding habitat. Availability of loafing sites probably important to continued use of feeding habitat.

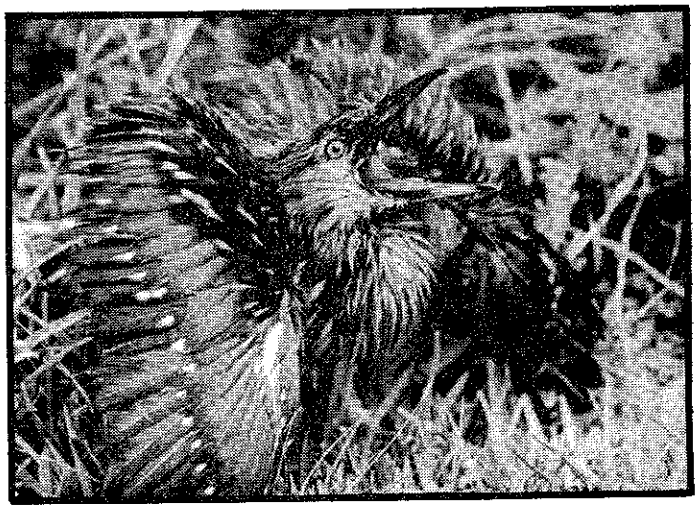
MORTALITY: Causes of mortality are numerous and varied; predators include dogs, cats, rats, bass and herons. Of less significance are mynas (probably attack eggs and young), owls and bullfrogs. Mongoose probably serious predator where Koloa have been introduced to former range (Hawaii, Oahu). Poaching for sport or food may be locally significant, and taro farmers suffering crop depradation probably kill some birds. Natural stream flooding and water level manipulation in irrigation ditches may destroy nests. Burning and harvesting of cane may pollute or destroy some habitat. Koloa have died in botulism outbreaks on both Kauai and Oahu. Suspected interbreeding between Koloa and feral (or migratory) Mallards could result in dilution of Koloa gene pool.

STATUS AND DISTRIBUTION: Endemic to Hawaii. Currently listed as "endangered" by State and Federal laws. Formerly found on all larger main islands and Niihau. Sought for food by Hawaiians, particularly during flightless period while molting. Henshaw (366) reported Koloa numerous in early years on Hawaii and Bryan (358) saw the species regularly on Molokai streams. Both authors implicated mongoose predation in the reduction of numbers. Perkins (387) recorded Koloa as high as 8,000 feet on Hawaii, but indicated that the species was sought after by sportsmen and had already become locally scarce. Population on Kauai was reportedly large until 1920's, then began to decline rapidly. Koloa have nested on offshore islets near Oahu but the wild population on Oahu was estimated at less than 30 birds in 1946 (399). Hunting for Koloa was closed on Kauai in 1925, but remained open for migratory waterfowl to 1939. Similarities in plumage to migratory birds probably resulted in little actual protection for Koloa while other species were still hunted legally. The Koloa population on Kauai was estimated at 3,000 birds in 1967 (406). Numbers recorded during semiannual surveys by State and Federal biologists probably bear little relationship to actual populations, as the species

is very widely distributed but rarely concentrated. Captive-reared birds have been released on both Hawaii and Oahu to restore those populations, but it is questionable whether or not these birds are breeding successfully in significant numbers. It may be several years before the success or failure of this project is confirmed.

Black-crowned Night Heron
'auku'u
Nycticorax nycticorax hoactli





NAMES: Black-crowned Night Heron (Fish hawk)
'auku'u, 'auku'u-kahili
Nycticorax nycticorax hoactli

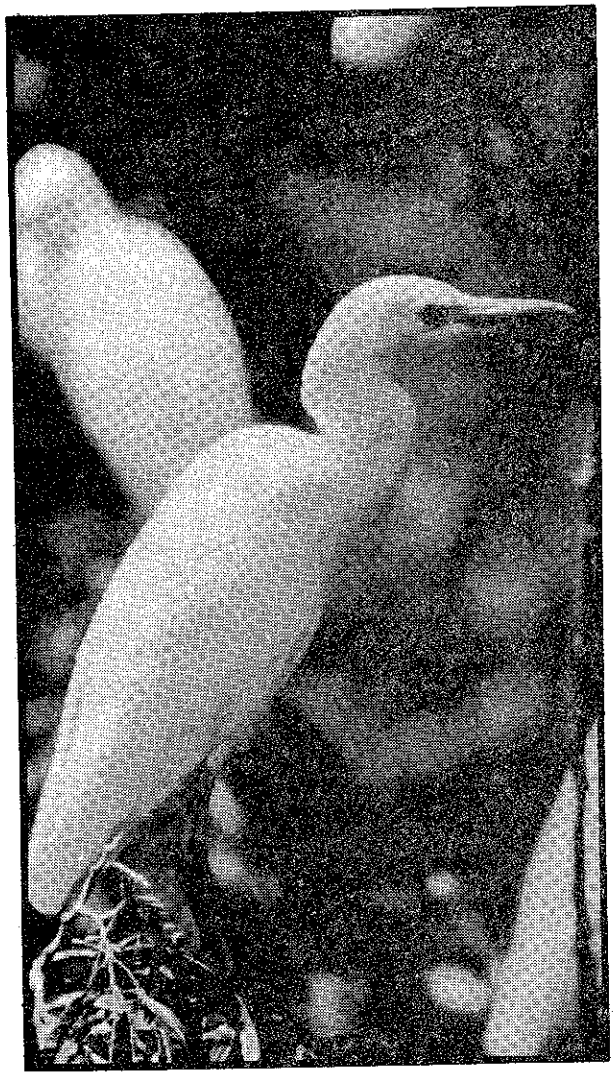
DESCRIPTION: Not believed to be morphologically distinct from other populations of this species whose distribution includes North and South America. 24-26"; sexes similar. Top of head, back and scapular region greenish-black; underparts and sides of head grayish-white; wings and tail gray. Legs and feet are yellow. Large bill is grayish-black. 2-3 long white plume feathers on head. Juvenile birds are streaked grayish-white and brown. Eye begins yellow in chick, turning to orange, then red in adult.

BREEDING BIOLOGY: May breed year around, but nesting activity concentrated April-August. Nests in colonies ranging from less than 10 to more than 150 birds. Most nests found in kiawe trees, but roosts may be in virtually any type of tree. Large complex nest platforms of sticks and leaves are built in the crotch of limbs or on strong horizontal branches. Limited observations indicate a clutch of 2-3 blue-green eggs in Hawaii (3-5 eggs in North America). Chicks are fed at the nest for several weeks, although they may move around in nearby branches. They feed independently of adults after leaving nest. Individual heron nests have been found within Cattle Egret colonies on Oahu.

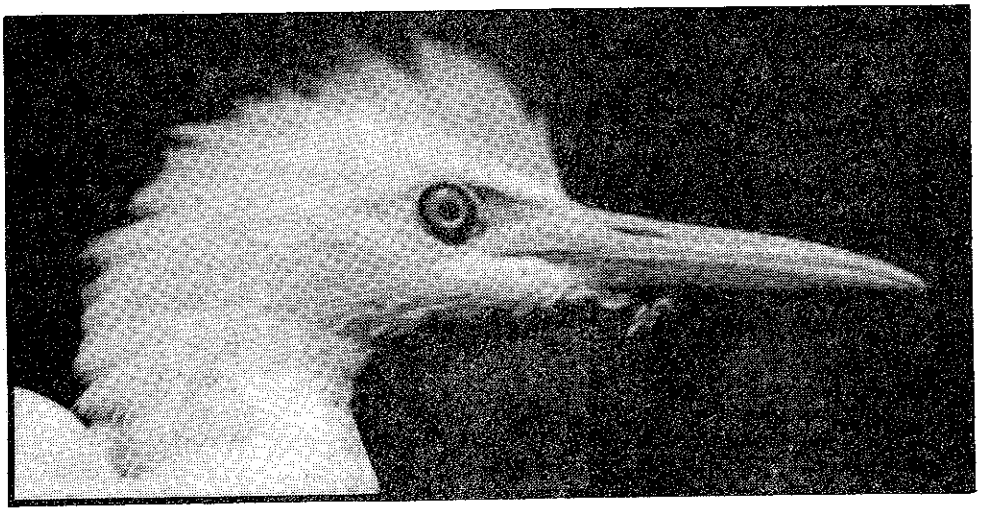
FEEDING ECOLOGY: Frequents ponds, marshes, lagoons, tidepools, streams, fishponds and other aquaculture facilities. Known to take a wide variety of foods including fish, frogs, crayfish, mice, large insects and downy chicks of some seabirds. Predation on tern chicks may be heavy in spring months. Adults and young regurgitate pellets containing indigestible hair, bones and feathers of their prey. May fly long distances in search of food. Wades in water up to 8" deep or more stalking food. May actually swim for short periods.

MORTALITY: Although unconfirmed, illegal shooting may be an important cause of mortality, particularly where herons are a nuisance in aquaculture operations. Population may be limited by shortage of suitable feeding habitat, but most breeding colonies have considerable room for expansion. Human disturbance in nesting colonies can cause extensive egg and chick mortality when adults leave their nests. Feeding birds are vulnerable to pollution that affects food supply, including pesticide accumulation in fishes.

STATUS AND DISTRIBUTION: Indigenous to Hawaii. Resident on all main islands, (except possibly Kahoolawe), but populations clearly diminished in recent history. Perkins (387) reported the species "very common" on all islands. He described heronries "more often from four to seven miles inland in groves of kukui at 1,000' or more above the sea". Still occasionally seen feeding in small numbers on inland streams, but nesting colonies are few and typically within one mile of coastline. Largest single concentration is on Maui, particularly in Kealia Pond area. At least four active nesting colonies are known on Oahu. Survey records only approximate real population numbers due to wide dispersal of birds in search of food. Although not listed as "endangered" as a species, the Hawaiian population may be as threatened as endemic waterbirds due to diminishing feeding habitat.



Cattle Egret
Bubulcus ibis



NAMES: Cattle Egret
Bubulcus ibis

DESCRIPTION: Recently introduced to Hawaii, so not morphologically distinct from other populations. 20"; sexes similar. Small, white heron with yellowish legs and bill. Some adults show buffish crown, breast and back in breeding season. Chicks covered with white down soon after hatching. Juvenile birds are white with greenish-black legs and bill. Eggs are light blue.

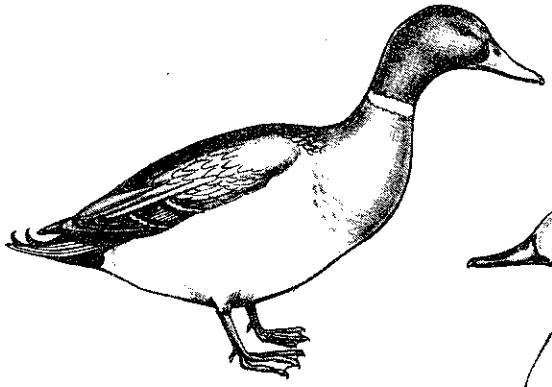
BREEDING BIOLOGY: Nest in dense rookeries year around, but most active in winter, spring and summer months. Platform stick nests built in kiawe, mangrove, koa haole or Christmas berry. Clutch of 2-3 eggs is laid. Chicks fed at the nest site or on nearby branches for several weeks after hatching. Nesting colonies have been established at several locations on Oahu, fewer on Hawaii and Kauai.

FEEDING ECOLOGY: Although not confined to wetlands, this bird will exploit wetland food resources. Egrets may range long distances from their colony in search of insects, crayfish, other invertebrates and frogs. Regularly seen in company with cattle and horses in pastures. Large flocks enter marshes and flooded pastures to feed. Very large numbers also gather to feed in cane settling basins, garbage dumps; less commonly in sewage ponds. Watercress farms provide source of crayfish and other invertebrates taken by egrets.

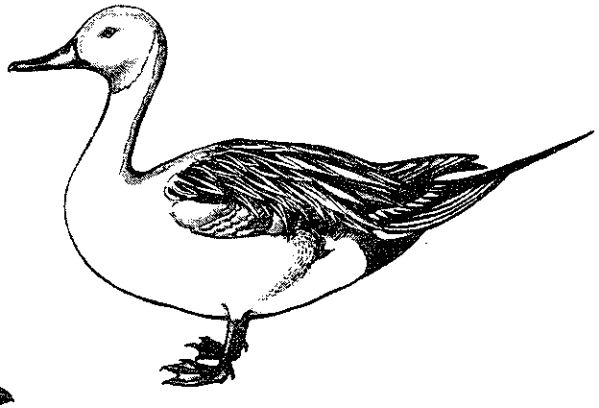
MORTALITY: Disturbance in nesting colonies may cause serious egg and chick losses when adults leave nest. Chicks that fall out of nests are often victims of predators. Mongoose and rats may enter trees and prey on eggs or young. Probably some are shot by taro and watercress farmers, or others.

STATUS AND DISTRIBUTION: Not native to Hawaii. A native of southern Eurasia and northern Africa. Species has expanded its range dramatically in last half century, into South and North America. Originally brought to Hawaii from Florida with funds supplied by local ranchers, in belief birds would aid in insect control around cattle (351). Nearly 150 birds released on Kauai, Molokai, Maui, Oahu and Hawaii in 1959 and 1961. First nesting observed in 1960 at Kahuku, Oahu, and soon after in Pearl Harbor area. Colony at Kaneohe Marine Corps Air Station estimated at 30 nests in 1970 (351), now several hundred active nests are present. Populations on Maui and Molokai have remained very low, with only slight increase shown on Hawaii. Kauai population began "explosive" increase in 1974, possibly assisted by influx of Oahu birds. The statewide population is not threatened by diminishing wetland habitat, nor is it receiving any conservation attention.

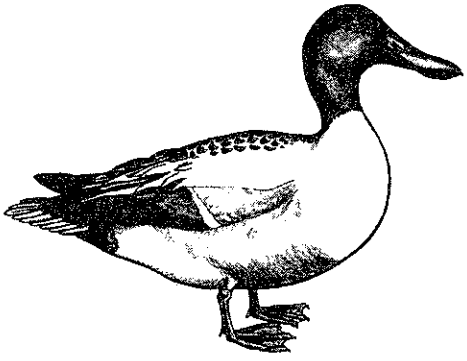
Migratory Waterfowl



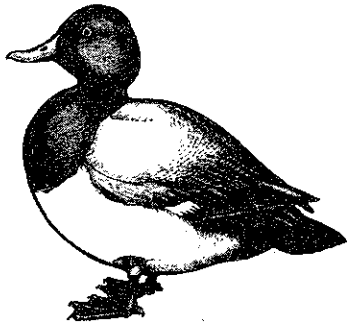
Mallard



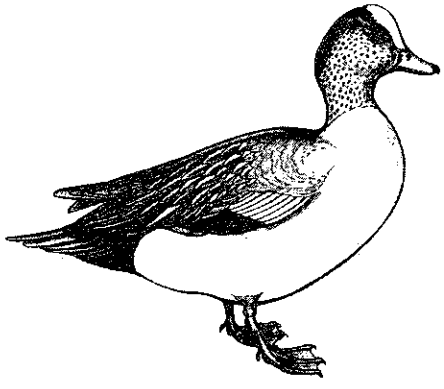
Pintail



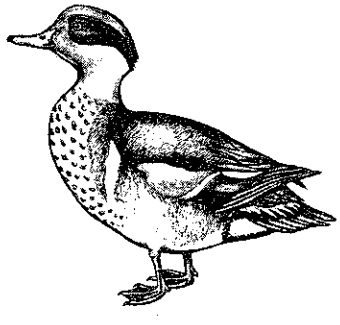
Northern Shoveler



Lesser Scaup



American Wigeon



Green-winged Teal

Illustration by R L Walker

MIGRATORY WATERFOWL

The list of migratory waterfowl species that have been recorded in Hawaii is large, considering the distance from the nearest continent (see page 41). Yet only a small percentage of these species are regular visitors in significant numbers. Pintails (Anas acuta) and Northern Shovelers (Anas clypeata) represent well over 90% of the migratory waterfowl recorded on winter counts (HDF&G/USF&WS) in the Islands. Most of the ducks recorded in Hawaii breed throughout much of North America, and may winter far south of their breeding sites (Mexico, Central and South America). Several species have been recorded on islands throughout much of the Central and South Pacific Ocean, where they pass through or spend the winter prior to their annual return to their nesting areas.

Banding records demonstrate that North American waterfowl appearing in Hawaii fly southwest to the Islands from the Pacific Flyway (375). Recaptures of ducks banded in the Islands confirm that these are not stragglers that will visit Hawaii only once (375). Waterfowl arrive in Hawaii's wetlands in mid-August to mid-September and do not begin to depart until late January. More than 80% of the birds may leave within a week once they begin to depart (375). A very small number of migratory ducks may remain in the Islands over the summer, but there is no evidence of breeding activity among these birds.

It seems certain that Hawaiians made use of migratory waterfowl for food, although birds were probably difficult to capture without guns (372). There were no accurate waterfowl counts made before mid-century, but wildlife biologists in the 1920's recognized the impact of extensive waterfowl hunting and eventually passed regulations to protect the ducks. Count records maintained since 1950 demonstrate unexplained year-to-year population variations as much as 200% or more. The largest recorded waterfowl population in the Islands was 10,462 in 1953, and Kauai was not even counted at that time (375). Nearly 5,000 ducks were found that year on Maui alone. Count data indicate that Maui and Oahu have generally wintered the greatest total numbers of migratory waterfowl, although numbers are down considerably in recent years from counts during the 1950's.

Pintails are generally more abundant than shovelers on all islands except at ponds on Maui, where the reverse is usually true. Presumably, this is due to difference in feeding ecology. Pintails tend to dive deeper and more often than other surface feeding ducks, although data from mainland studies indicate that they rely heavily on the seeds and vegetative parts of various submergent, floating and emergent wetland plants (Scirpus, Potamogeton, Ruppia, Polygonum - 220). Shovelers tend to consume more small aquatic animals than other surface feeding ducks, but other studies confirm that they also take several varieties of wetland plants (Lemnaceae, Potamogeton, Ruppia, Scirpus, Chara, Eleocharis - 220). Other birds on the list of occasional migrant waterfowl species display a wide diversity in feeding habits (diving ducks, dabbling ducks, fish-eating ducks).

Mallards (Anas platyrhynchos) appear irregularly in several wetland areas in Hawaii. However, the Hawaiian population appears to be made up largely of non-migratory feral birds that stem from domestic broods in private ponds throughout

the State, but particularly on Oahu. Similarity in genetic lineage and frequent association in the wild with native Koloa (Anas wyvilliana) has generated serious concern among local biologists about interbreeding and consequent gene dilution of the endemic species. Mallard control programs have been considered to minimize the problem, but if proposed they would surely meet with considerable opposition.

As is the case with native waterbirds, the number and distribution of migratory waterfowl in Hawaii is dependent upon the condition and amount of suitable habitat. The wetlands used most frequently by migratory waterfowl are shallow enough to support an accessible aquatic food supply, yet also provide sufficient cover, isolation from human disturbance, and sloping shorelines or small islets that are used by "loafing" (resting) ducks. Some areas, particularly on Oahu, where migratory ducks were formerly common in winter months, have been lost or severely degraded as productive waterfowl habitat (Kuapa Pond, Kaelepulu Pond, Waikiki ponds). Other areas are losing their value as gradual siltation and encroachment of vegetation diminishes available open water and feeding habitat. Biologists believe that some illegal shooting still occurs, although this is probably of little significance. Predation may also result in the loss of a few birds, although migratory ducks are far less vulnerable than native waterbirds because they do not nest in the Islands. Botulism losses in the Islands have been relatively minor to date, but concentration of ducks on a limited number of sites increases the threat of more serious outbreaks of this and other disease in the future.

Table 1.

NON-RESIDENT (MIGRATORY) WATERFOWL RECORDED IN THE HAWAIIAN ISLANDS

(Reference 393)

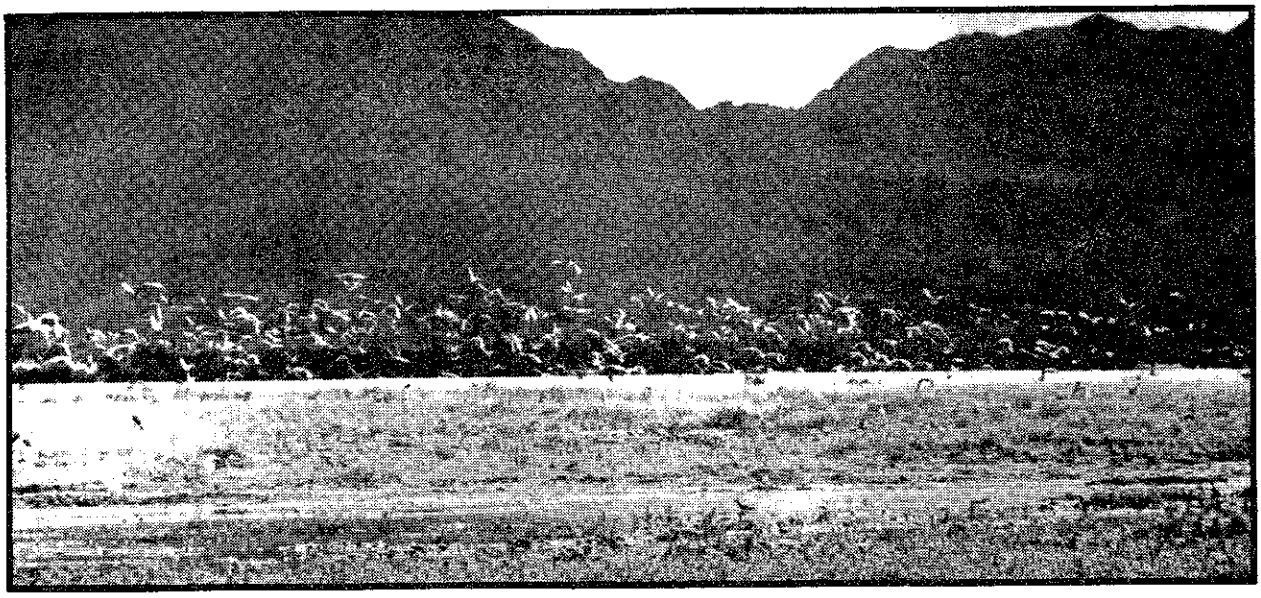
KEY: R - regular migrant to Hawaii
O - occasional to frequent migrant to Hawaii
S - accidental straggler to Hawaii; at least one well-substantiated record since 1960
X - accidental straggler to Hawaii; no well-substantiated published record since 1960

Family Anatidae

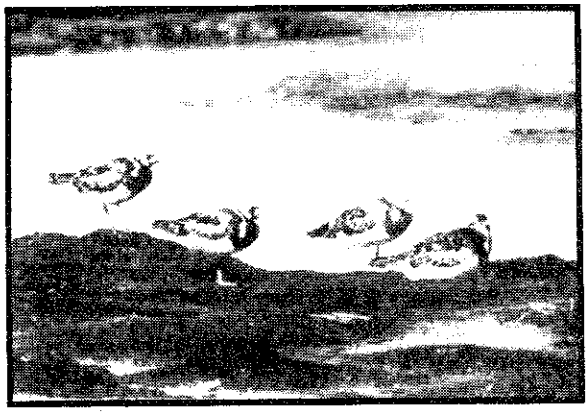
Canada Goose (cackling subspecies)	*Branta canadensis (minima)*	O
Brant	*Branta bernicla*	O
Emperor Goose	*Philacte canagica*	S
White-fronted Goose	*Anser albifrons*	S
Snow Goose	*Chen caerulescens*	S
Mallard	*Anas platyrhynchos*	R
Gadwall	*Anas strepera*	S
Pintail	*Anas acuta*	R
Garganey Teal	*Anas querquedula*	S
Green-winged Teal	*Anas crecca*	R
Blue-winged Teal	*Anas discors*	S
Cinnamon Teal	*Anas cyanoptera*	S
European Wigeon	*Anas penelope*	S
American Wigeon	*Anas americana*	R
Northern Shoveler	*Anas clypeata*	R
Redhead	*Aythya americana*	S
Ring-necked Duck	*Aythya collaris*	S
Canvasback	*Aythya valisineria*	S
Greater Scaup	*Aythya marila*	S
Lesser Scaup	*Aythya affinis*	R

Table 1. (continued)

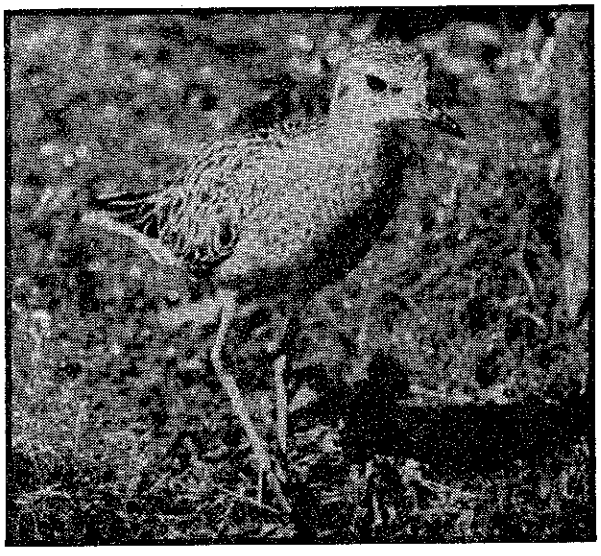
Tufted Duck	*Aythya fuligula*	S
Bufflehead	*Bucephala albeola*	O
Oldsquaw	*Clangula hyemalis*	X
Harlequin Duck	*Histrionicus histrionicus*	S
Surf Scoter	*Melanitta perspicillata*	S
Ruddy Duck	*Oxyura jamaicensis*	S
Hooded Merganser	*Lophodytes cucullatus*	S
Red-breasted Merganser	*Mergus serrator*	X



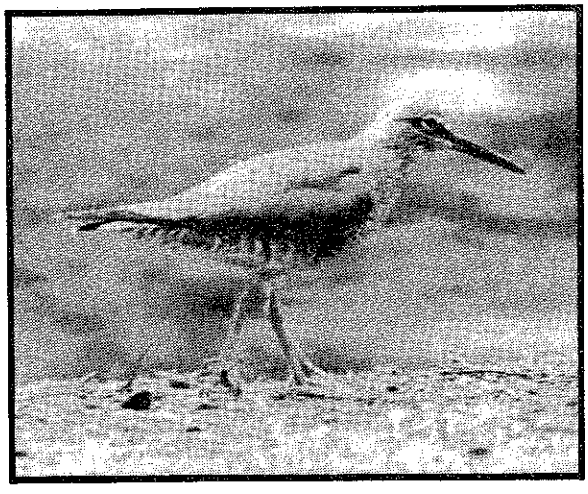
Mixed flock of shorebirds at Kaneohe Marine Corps Air Station



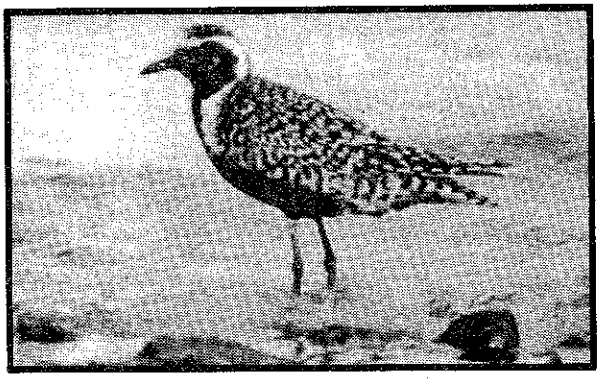
Ruddy Turnstone ('akekeke)



American Golden Plover (kolea)



Wandering Tattler ('ulili)



Plover in breeding plumage

MIGRATORY SHOREBIRDS

The term "shorebird" is somewhat of a misnomer when applied to most species on the long list of small wading birds that migrate to Hawaii. More than 30 species have been recorded in Hawaii (page 46), and most of the observations were made in low elevation wetlands (mudflats, settling basins, brackish ponds, and taro fields). The more common species sometimes gather in large flocks, sometimes numbering several hundred. In winter plumage, many similar species are difficult to distinguish by all but the most experienced observers.

Four shorebird species are more frequent visitors to the Islands than all the others put together: American Golden Plover, Ruddy Turnstone, Sanderling and Wandering Tattler. Another six to eight species are seen with some regularity in the Islands, but never in large numbers. Of the four most common species, Golden Plovers arrive in the largest numbers and visit by far the widest variety of natural and man-made habitats. Any lawn or pasture from sea level to 8,000 feet or more may attract this species. Golden Plovers also share mudflats and other wetlands with large flocks of turnstones and Sanderlings. Tattlers, on the other hand, are far less prone to flocking, but are more apt to be found alone or in small numbers seeking food along rocky shorelines, mudflats, taro fields and even inland streams. All the shorebirds may subdivide available habitat by wading in different depths, or by probing for food in different ways. Their prey may differ considerably, although they will share temporarily abundant food resources (worms, molluscs, crustaceans, small fish, etc.). These birds may range widely in the Islands, taking advantage of tidal patterns and other factors that affect the abundance of food. Of all the native waterbirds, the Hawaiian Stilt is most likely to share habitat with the migratory shorebirds, although in some areas (i.e. taro fields on Kauai) all species may be found together. Migratory shorebirds begin to arrive in the Islands in late August each year and leave for temperate zone breeding grounds as late as April or early May. Some individuals, particularly Golden Plovers and Wandering Tattlers, may stay the summer in Hawaii, but these birds usually fail to attain their normal breeding plumage.

Golden Plovers, and less commonly other migratory shorebirds, were regularly shot as game birds by sportsmen until 1939. Perkins (387) reports that plovers were often shot over decoys. He also indicated that hunting had reduced numbers of plovers considerably. Although some large habitat areas have been eliminated in recent years, counts by State and Federal biologists over the last 20 years do not reflect decreasing numbers in the Islands. As is the case with other migratory species, radical year-to-year fluctuations in numbers counted seem to mask any apparent trends in actual population. Variations in tides, weather and count coverage probably have more affect on the accuracy on count records for shorebirds than other waterbirds.

Mortality of migratory shorebirds probably has only a minimal effect on populations in the Islands, although many birds may die in the Arctic breeding grounds, and possibly during the long trans-ocean migration. Some mortality in the Islands may result from illegal shooting, pollution of habitat, collision with automobiles,

and disease, although the relative importance of these factors has not been documented. A small number are killed by aircraft in airport areas. Predation on shorebirds is probably insignificant in the Islands, although mongoose, owls, herons and even hawks (at higher elevations) may take a small toll.

Table 2.

NON-RESIDENT (MIGRATORY) SHOREBIRDS RECORDED IN THE HAWAIIAN ISLANDS

(Reference - 393)

KEY: R - regular migrant to Hawaii
O - occasional to frequent migrant to Hawaii
S - accidental straggler to Hawaii; at least one well-substantiated record since 1960
X - accidental straggler to Hawaii; no well-substantiated published record since 1960

Family Charadriidae		
Semipalmated Plover	Charadrius semipalmatus	O
Snowy Plover	Charadrius alexandrinus	S
Mongolian Plover	Charadrius mongolus	S
Killdeer	Charadrius vociferus	S
Dotterel	Eudromias morinellus	S
American Golden Plover	Pluvialis dominica	R
Black-bellied Plover	Pluvialis squatarola	R
Family Scolopacidae		
Common Snipe	Capella gallinago	O
Pintail Snipe	Capella stenura	S
Whimbrel	Numenius phaeopus	S
Bristle-thighed Curlew	Numenius tahitiensis	R
Wood Sandpiper	Tringa glareola	S
Greater Yellowlegs	Tringa melanoleuca	S
Lesser Yellowlegs	Tringa flavipes	O
Wandering Tattler	Heteroscelus incanus	R
Polynesian Tattler	Heteroscelus brevipes	S
Ruddy Turnstone	Arenaria interpres	R
Willet	Catoptrophorus semipalmatus	S
Red Knot	Calidris canutus	S
Sharp-tailed Sandpiper	Calidris acuminata	R

Table 2. (continued)

Pectoral Sandpiper	Calidris melanotos	R
Baird Sandpiper	Calidris bairdii	S
Least Sandpiper	Calidris minutilla	S
Long-toed Stint	Calidris subminuta	S
Dunlin	Calidris alpina	O
Western Sandpiper	Calidris mauri	O
Sanderling	Calidris alba	R
Short-billed Dowitcher	Limnodromus griseus	S
Long-billed Dowitcher	Limnodromus scolopaceus	O
Marbled Godwit	Limosa fedoa	S
Bar-tailed Godwit	Limosa lapponica	S
Ruff	Philomachus pugnax	S
Family Phalaropodidae		
Red Phalarope	Phalaropus fulicarius	S
Wilson Phalarope	Steganopus tricolor	S
Northern Phalarope	Lobipes lobatus	S

Species Pairs

The following species pairs represent well-substantiated sightings of one of a species pair difficult to distinguish in winter plumage, recorded in Hawaii since 1960.

Spotted/Common Sandpiper	Actitis macularia or A. hypoleucos (SCOLOPACIDAE)
Hudsonian/Black-tailed Godwit	Limosa haemastica or L. limosa (SCOLOPACIDAE)

SEABIRDS IN WETLANDS

A small number of resident and migratory seabirds have been recorded in Hawaii wetlands. Of the 22 species of seabirds that nest in Hawaii (page 49), only two make regular use of wetland habitat. Great Frigatebirds (Fregata minor) nest or roost on several small offshore islets, and visit coastal fresh water or brackish wetlands in small numbers to catch fish and drink. Rarely are more than a half dozen birds seen together in a wetland area. Black Noddies (Anous tenuirostris) nest on rocky coastal ledges on the main islands and visit brackish marshes and coastal fishponds, occasionally in groups of several dozen or more. They generally feed independently, however, while hovering at the water surface. Most food for this species, however, is derived from coastal waters, rather than wetlands.

More than a dozen non-resident species of gulls and terns have been recorded in the Islands (page 51), and many of these have been recorded only in wetlands (brackish ponds, settling basins, estuaries, etc.). Although a few of these species are seen nearly every winter, the total number of individual non-resident gulls and terns observed annually in the State rarely exceeds a dozen. Some individuals are seen repeatedly throughout the season in a single wetland habitat. Whether or not individual birds return to Hawaii in successive years can only be answered through banding studies, but it is clear that these are stragglers from distant populations and have little effect on the ecology of Hawaiian wetlands.

Table 3. Resident Seabirds

Note: Distribution is for verified breeding populations only.
Island distribution includes offshore islets.

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	CATEGORY							DISTRIBUTION										
			Extinct	Endangered - Federal	Threatened - Federal	Endangered - State	Endemic	Indigenous	Exotic	All Main Islands	Hawaii	Kahoolawe	Maui	Molokai	Lanai	Oahu	Kauai	Niihau	Kaula	Northwest Islands
Family DIOMEDEIDAE																				
Diomedea nigripes	Black-footed Albatross							x												x
Diomedea immutabilis	Laysan Albatross	mōlī						x												x
Family PROCELLARIIDAE																				
Puffinus pacificus chlororhynchus	Wedge-tailed Shearwater	ʻuaʻu-kani						x								x	x	x	x	x
Puffinus nativitatis	Christmas Shearwater							x								x			x	x
Puffinus puffinus newelli	Newell's Shearwater	ʻaʻo			x	x	x										x			
Pterodroma phaeopygia sandwichensis	Hawaiian Petrel	ʻuaʻu		x		x	x				x		x							x
Pterodroma hypoleuca	Bonin Petrel							x												x
Bulweria bulwerii	Bulwer's Petrel	ʻou						x			x		x			x		x	x	x
Family HYDROBATIDAE																				
Oceanodroma castro cryptoleucura	Hawaiian Storm-petrel	ʻakēʻakē, oeoe				x	x										x			
Oceanodroma tristrami	Sooty Storm-petrel																			
Family PHAETHONTIDAE																				
Phaethon lepturus dorotheae	White-tailed Tropicbird	koaʻe-kea						x			x		x				x			
Phaethon rubricauda rothschildi	Red-tailed Tropicbird	koaʻe-ʻula						x							x		x	x	x	x
Family SULIDAE																				
Sula dactylatra personata	Blue-faced Booby	ʻā						x								x		x	x	x
Sula leucogaster plotus	Brown Booby	ʻā						x								x		x	x	x
Sula sula rubripes	Red-footed Booby	ʻā						x								x	x	x	x	x
Family FREGATIDAE																				
Fregata minor palmerstoni	Great Frigatebird	ʻiwa						x					x			x	x	x	x	x

Table 3. (continued)

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	CATEGORY						DISTRIBUTION									
			Extinct	Endangered - Federal	Threatened - Federal	Endangered - State	Endemic	Indigenous	Exotic	All Main Islands	Hawaii	Kahoolawe	Maui	Molokai	Lanai	Oahu	Kauai	Niihau	Kaula	Northwest Islands
Family LARIDAE																				
Sterna fuscata oahuensis	Sooty Tern	'ewa'ewa						x								x		x	x	x
Sterna lunata	Gray-backed Tern	pākalakala						x								x		x	x	x
Procelsterna cerula saxatilis	Blue-gray Noddy							x								x		x	x	x
Anous stolidus pileatus	Brown (Common) Noddy	noio kōhā						x								x		x	x	x
Anous tenuirostris melanogenys	Black (White-capped) Noddy	noio, 'eki'eki						x					x			x	x	x	x	x
Gygis alba rothschildi	White (Fairy) Tern	manu-o-Ku				*		x		x						x		x	x	x

* listed as endangered on the island of Oahu only.