

Table 4.

NON-RESIDENT (MIGRATORY) SEABIRDS RECORDED IN HAWAIIAN WETLANDS

(Reference - 393)

KEY: R - regular migrant to Hawaii
 0 - 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 Stercorariidae

Pomarine Jaeger	<u>Stercorarius pomarinus</u>	R
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Family Laridae

Glaucous Gull	<u>Larus hyperboreus</u>	0
Glaucous-winged Gull	<u>Larus glaucescens</u>	0
Slaty-backed Gull	<u>Larus schistisagus</u>	S
Western Gull	<u>Larus occidentalis</u>	S
Herring Gull	<u>Larus argentatus</u>	0
California Gull	<u>Larus californicus</u>	S
Ring-billed Gull	<u>Larus delawarensis</u>	S
Black-headed Gull	<u>Larus ridibundus</u>	S
Laughing Gull	<u>Larus atricilla</u>	S
Franklin Gull	<u>Larus pipixcan</u>	0
Bonaparte Gull	<u>Larus philadelphia</u>	S
Black-legged Kittiwake	<u>Rissa tridactyla</u>	S
Common Tern	<u>Sterna hirundo</u>	S
Least Tern	<u>Sterna albifrons</u>	0
Black Tern	<u>Chlidonias niger</u>	S

OTHER NON-RESIDENT SPECIES IN WETLANDS

A small number of additional non-resident species have been seen in Hawaiian wetlands, but do not fit in the other categories. Some of these (i.e. Osprey) have been seen more regularly than others, but never in significant numbers. As a rule, past records have not accounted for more than single individuals of a species in a particular wetland habitat. As is the case for non-resident seabirds, these straggler species probably have little effect on wetland ecology in Hawaii. A possible exception may be the temporary impact of predatory species (Marsh Hawk, Peregrine Falcon) on native birdlife.

Table 5.

OTHER NON-RESIDENT (MIGRATORY) SPECIES 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 Gaviidae

Arctic Loon	<u>Gavia artica</u>	S
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Family Podicipedidae

Horned Grebe	<u>Podiceps auritus</u>	S
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Pied-billed Grebe	<u>Podilymbus podiceps</u>	S
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Family Ardeidae

Great Blue Heron	<u>Ardea herodias</u>	S
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Little Blue Heron	<u>Florida caerulea</u>	S
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Great Egret	<u>Casmerodius albus</u>	X
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Family Accipitridae

Marsh Hawk	<u>Circus cyaneus</u>	S
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Family Pandionidae

Osprey	<u>Pandion haliaetus</u>	O
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Family Falconidae

Peregrine Falcon	<u>Falco peregrinus</u>	S
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Family Alcedinidae

Belted Kingfisher	<u>Megaceryle alcyon</u>	X
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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.

Snowy/Little Egret	<u>Egretta thula</u> or <u>Egretta garzetta</u> (ARDEIDAE)
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Glossy/White-faced Ibis	<u>Plegadis chihi</u> or <u>P. falcinellus</u> (THRESKIORNITHIDAE)
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OTHER NATIVE (RESIDENT) BIRD SPECIES

If one includes higher elevation forested bogs and swamps in the definition of "wetland", then the list of native birds resident in these areas is quite long. The most obvious example of this situation is the Alakai Swamp on Kauai, where 14 species of native forest birds (including the Hawaiian Owl) are still believed to be extant. A true waterbird, the Hawaiian Duck, is also found within this high elevation forested habitat.

Our survey list included some sites in which the predominant vegetation consisted of native forest trees and shrubs on Kauai (Kalihiwai), Maui (Kipahulu Valley bog), and Hawaii (Ki'ilae forested bog, Na Manu'a Ha'alou). Of these areas, only Ki'ilae forested bog and Kalihiwai were actually visited on the ground, because our primary emphasis was on true waterbird habitat. Native forest birds recorded during these surveys are included in the appropriate site discussions. A list of native passerine and non-passerine birds (excluding waterbirds and seabirds), with information on island distribution, is found on pages 55-58.

Table 6.
NATIVE PASSERINE BIRDS (cont'd)

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	CATEGORY		DISTRIBUTION													
			Endangered - Federal	Threatened - Federal	All Main Islands	Hawaii	Kahoolawe	Maui	Molokai	Lanai	Oahu	Kauai	Niihau	Kaula	Northwest Islands			
Family DREPANIDIDAE																		
Sub-family PSITTOSTRINAE																		
<u>Loxops virens virens</u>	Hawaii Amakihi	'amakihi																
<u>Loxops virens wilsoni</u>	Maui Amakihi	'amakihi																
<u>Loxops virens chloris</u>	Oahu Amakihi	'amakihi																
<u>Loxops virens steinegeri</u>	Kauai Amakihi	'amakihi																
<u>Loxops parva</u>	Lesser Amakihi	'anianiau																
<u>Loxops sagittirostris</u>	Greater Amakihi																	
<u>Loxops maculata mana</u>	Hawaii Creeper																	
<u>Loxops maculata montana</u>	Lanai Creeper																	
<u>Loxops maculata flammea</u>	Molokai Creeper																	
<u>Loxops maculata newtoni</u>	Maui Creeper																	
<u>Loxops maculata maculata</u>	Oahu Creeper																	
<u>Loxops maculata bairdi</u>	Kauai Creeper																	
<u>Loxops coccinea coccinea</u>	Hawaii Akepa	'akepa																
<u>Loxops coccinea ochracea</u>	Maui Akepa	'akepeu'ie																
<u>Loxops coccinea rufa</u>	Oahu Akepa	'akepeu'ie																
<u>Loxops coccinea caeruleirostris</u>	Kauai Akepa	'o'u-holo-wai, 'akeke'e																
<u>Melamprosops phaeosoma</u>	Poo Uli	po'o uli																

* Listed as Endangered on the island of Lanai only.

Table 6.
NATIVE PASSERINE BIRDS (cont'd)

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	DISTRIBUTION																						
			All Main Islands	Hawaii	Kahoolawe	Maui	Molokai	Lanai	Oahu	Kauai	Niihau	Kaula	Northwest Islands												
			CATEGORY																						
			Extinct	Endangered - Federal	Threatened - Federal	Endangered - State	Endemic	Indigenous	Exotic																
<i>(Sub-family PSITTIROSTRINAE, continued)</i>																									
<i>Hemignathus obscurus obscurus</i>	Hawaii Akialoa	'akialoa																							
<i>Hemignathus obscurus lanaiensis</i>	Lanai Akialoa	'akialoa																							
<i>Hemignathus obscurus ellisianus</i>	Oahu Akialoa	'akialoa											f												
<i>Hemignathus procerus</i>	Kauai Akialoa	'akialoa																							
<i>Hemignathus lucidus lucidus</i>	Oahu Nukupuu	nuku-pu'u																							
<i>Hemignathus lucidus affinis</i>	Maui Nukupuu	nuku-pu'u																							
<i>Hemignathus lucidus hanapepe</i>	Kauai Nukupuu	nuku-pu'u																							
<i>Hemignathus wilsoni</i>	Akiapolaau (Hawaii Nukupuu)	'akiapola'au																							
<i>Pseudonester xanthophrys</i>	Maui Parrotbill	'o'u																							
<i>Psittirostra psittacea</i>	Ou	'o'u																							
<i>Psittirostra cantans cantans</i>	Laysan Finch	palila																							
<i>Psittirostra cantans cantans ultima</i>	Nihoan Finch	hopue																							
<i>Psittirostra baillieui</i>	Palila	palila																							
<i>Psittirostra palmeri</i>	Greater Koa Finch	hopue																							
<i>Psittirostra flaviceps</i>	Lesser Koa Finch	hopue																							
<i>Psittirostra kona</i>	Kona (Grossbeak) Finch	hopue																							
<i>Sub-family DREPANIDINAE</i>																									
<i>Himatone sanguinea sanguinea</i>	Apapane	'apapane																							
<i>Himatone sanguinea freethii</i>	Laysan Honeycreeper	'akohekohe																							
<i>Palmeria dolei</i>	Crested Honeycreeper	'ula-'ai-hawane																							
<i>Ciridops anna</i>	Iiwi	'i'iwi																							
<i>Vestiaria coccinea</i>	Mamo	mamo																							
<i>Drepanis pacifica</i>	Black Mamo	'oo-ruku-mu, hoa																							
<i>Drepanis funerea</i>	Black Mamo	'oo-ruku-mu, hoa																							
* Listed as Endangered on the island of Lanai only.																									
+ Listed as Endangered on the islands Oahu and Molokai only.																									

Table 7.

NATIVE NON-PASSERINE LAND BIRDS

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	CATEGORY																		
			Endangered - State	Threatened - Federal	Endangered - Federal	Extinct	DISTRIBUTION														
Family ANATIDAE																					
<u>Branta sandvicensis</u>	Hawaiian Goose	nēnē	X													X					
Family ACCIPITRIDAE																					
<u>Buteo solitarius</u>	Hawaiian Hawk	'io															X	X			
Family STRIGIDAE																					
<u>Asio flammeus sandwichensis</u>	Hawaiian Owl	pueo																			X

* listed as endangered on the island of Oahu only.

OTHER INTRODUCED BIRD SPECIES

More than 150 species of exotic birds have been brought to Hawaii by man. Approximately half of these were introduced as game birds in the hope that they would establish populations that would sustain continued hunting. Fewer than one-third of the introduced game birds are breeding successfully in the wild (page 60). At least 12 species are regularly hunted on private lands and State game management areas. Many of the game birds frequent wetland areas, and are mentioned for those sites at which they were observed during this survey.

Nearly forty species of introduced non-game birds are believed to have established breeding populations in the wild (page 61). Some of these were purposely introduced to control insects, while others escaped from cages or were imported intentionally to "decorate" the urban landscape. Some species are now widespread while others are restricted in distribution and numbers. The Cattle Egret (Bubulcus ibis) is considered independently (page 37) because it has become an integral part of the Hawaiian wetland avifauna since its introduction. None of the other species are found exclusively in Hawaiian wetlands, although some (Spotted Munia, Black-headed Munia, Common Myna, Japanese White-eye) are quite common in this type of habitat. A species list for introduced non-game birds, with indications of relative abundance, was maintained during our site surveys. These species were not considered in the evaluation of habitat.

Table 9.

INTRODUCED NON-GAME BIRDS

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	CATEGORY															
			Extinct	Endangered - Federal	Threatened - Federal	Endangered - State	Endemic	Indigenous	Exotic	All Main Islands	Hawaii	Kahoolawe	Mau					
Family ARDEIDAE																		
<u>Bulbulcus ibis</u>	Cattle Egret																	
Family COLUMBIDAE																		
<u>Zenaidura macroura</u>	Mourning Dove																	
Family TYTOIDAE																		
<u>Tyto alba</u>	Barn Owl																	
Family APODIDAE																		
<u>Collocalia vanikorensis bartshi</u>	Vanikoro Swiftlet																	
Family ALAUDIDAE																		
<u>Alauda arvensis arvensis</u>	Skylark																	
Family TIMALIIDAE																		
<u>Geryllax pectoralis</u>	Greater Necklaced Laughing-thrush																	
<u>Geryllax canorus</u>	Melodious Laughing-thrush (Chinese Thrush)																	
<u>Leiothrix lutea</u>	Red-billed Leiothrix																	
Family PYCNONOTIDAE																		
<u>Pycnonotus jocosus</u>	Red-whiskered Bulbul																	
<u>Pycnonotus cafer</u>	Red-vented Bulbul																	
Family MIMIDAE																		
<u>Mimus polyglottos</u>	Mockingbird																	
Family TURDIDAE																		
<u>Copsychus malabaricus</u>	Shama Thrush																	

Table 9.

INTRODUCED NON-GAME BIRDS (cont'd)

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	DISTRIBUTION															
			Northwest Islands	Kaula	Niihau	Kauai	Oahu	Lanai	Molokai	Maui	Kahoolawe	Hawaii	All Main Islands					
			CATEGORY															
			Exotic	Indigenous	Endemic	Endangered - State	Threatened - Federal	Endangered - Federal	Extinct									
Family SYLVIIDAE																		
<u>Cettia diphone</u>	Japanese Bush Warbler (Uguisu)		x															
Family ZOSTEROPIDAE																		
<u>Zosterops japonica japonica</u>	Japanese White-eye (Mejiro)			x														
Family STURIDAE																		
<u>Acridotheres tristis</u>	Common Myna	piha-'ekelo																
<u>Gracula religiosa</u>	Hill Myna																	
Family ICTERIDAE																		
<u>Sturnella neglecta</u>	Western Meadowlark																	
Family PLOCEIDAE																		
<u>Uraeginthus bengalus</u>	Red-cheeked Cordon-bleu																	
<u>Estrilda caerulescens</u>	Lavender Fire-finch																	
<u>Estrilda melpoda</u>	Orange-cheeked Waxbill																	
<u>Estrilda troglodytes</u>	Red-eared Waxbill																	
<u>Amandava amandava</u>	Red Munia (Strawberry Finch)																	
<u>Lonchura malabarica</u>	Warbling Silverbill (White-throated Munia)																	
<u>Lonchura punctulata</u>	Spotted Munia (Ricebird)	manu-'ai'laiiki																
<u>Lonchura malacca</u>	Black-headed Munia (Black-headed Mannikin)																	
<u>Padda oryzivora</u>	Java Sparrow																	
<u>Vidua macroura</u>	Pin-tailed Whydah																	
<u>Passer domesticus</u>	House Sparrow	manu-li'ilili'i																

Table 9.
INTRODUCED NON-GAME BIRDS (cont'd)

SCIENTIFIC NAME	COMMON NAME	HAWAIIAN NAME	CATEGORY																		
			Exotic	Indigenous	Endemic	Endangered - State	Threatened - Federal	Endangered - Federal	Extinct	DISTRIBUTION											
Family FRINGILLIDAE	Saffron Finch		x																		
<u>Sicalis flaveola</u>	Red-crested Cardinal (Brazilian Cardinal)		x																		
<u>Paroaria coronata</u>	Yellow-billed Cardinal		x																		
<u>Paroaria capitata</u>	Northern Cardinal	'ula'ula	x																		
<u>Cardinalis cardinalis</u>	(American Cardinal, Kentucky Cardinal) Canary	manu-mele	x																		
<u>Serinus canaria</u>	Yellow-fronted Canary	'ai-mikana																			
<u>Serinus mozambicus</u>	House Finch																				
<u>Carpodacus mexicanus</u>																					

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BIBLIOGRAPHY

The scope of work for this contract specified the need to identify relevant source material on wetlands and waterbirds. This bibliography includes a listing of published and unpublished documents used in preparation of this report. All references in the report are by number, as it appears in this bibliography. Many additional unreferenced publications are listed because of their relevance to material presented in this report. These include many publications on waterbirds that are related to Hawaiian species, on studies of wetland resources in other areas and on study or management techniques involving wetlands and waterbirds.

The main body of the bibliography is divided into five sections, although all citations are listed consecutively regardless of section in the bibliography. Three additional sections include unpublished reports of ongoing research between 1971-1977 by the Hawaii Division of Fish and Game biologists (Job Progress Reports), additional Elepaio citations and a list of persons who provided unpublished information by personal communication.

	<u>References</u>	<u>Page</u>
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Job Progress Reports: Division of Fish and Game,
Dept. of Land & Natural Resources, State of Hawaii

Project Title: STATEWIDE PITTMAN-ROBERTSON PROGRAM

<u>Job Title</u>	<u>Project No.</u>	<u>Job No.</u>
454. Annual Survey and Inventory of Migratory and Non-Migratory Waterfowl and Shorebirds on the Island of Hawaii, 1971.	W-15-1	VII-A (20)
455. _____, 1972.	W-15-2	VII-A (21)
456. _____, 1973.	W-15-3	VII-A (22)
457. _____, 1974.	W-15-4	VII-A (23)
458. _____, 1975.	W-15-5	VII-A (24)
459. Annual Inventory of Migratory and Non-Migratory Waterfowl and Shorebirds in Maui County, 1971.	W-15-1	VII-B (20)
460. _____, 1972.	W-15-2	VII-B (21)
461. _____, 1973.	W-15-3	VII-B (22)
462. _____, 1974.	W-15-4	VII-B (23)
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464. Annual Survey and Inventory of Migratory and Non-Migratory Waterfowl and Shorebirds on the Island of Oahu, 1971.	W-15-1	VII-C (20)
465. _____, 1972.	W-15-2	VII-C (21)
466. _____, 1973.	W-15-3	VII-C (22)
467. _____, 1974.	W-15-4	VII-C (23)
468. _____, 1975.	W-15-5	VII-C (24)
469. Annual Inventory of Migratory and Non-Migratory Waterfowl and Shorebirds on the Island of Kauai, 1971.	W-15-1	VII-D (16)
470. _____, 1972.	W-15-2	VII-D (17)
471. _____, 1973.	W-15-3	VII-D (18)
472. _____, 1974.	W-15-4	VII-D (19)
473. _____, 1975.	W-15-5	VII-D (20)
474. Limited Surveys of Dispersal and Survival of Koloa Released on the Island of Hawaii, 1974.	W-15-4	VIII-A (4)
475. _____, 1975.	W-15-5	VIII-A (5)
476. Evaluation of Koloa Releases on the Island of Hawaii, 1975.	W-15-5	VIII-B (1)
477. Field Investigation of Native Hawaiian Waterbirds on the Island of Kauai, 1974.	W-15-4	VIII-C (4)
478. _____, 1975.	W-15-5	VIII-C (5)
479. Field Investigation of Native Hawaiian Waterbirds on the Island of Oahu, 1974.	W-15-4	VIII-D (1)
✓ 480. _____, 1975.	W-15-5	VIII-D (2)

Project Title: STATEWIDE NON-GAME AND ENDANGERED SPECIES PROGRAM

<u>Job Title</u>	<u>Project No.</u>	<u>Job No.</u>
481. Surveys and Inventories of Waterbirds and Their Habitats in the State of Hawaii, 1976.	W-18-R-1	R-III-A
482. Dispersal and Survival of Pen-reared Koloa on the Islands of Hawaii and Oahu, 1976.	W-18-R-1	R-III-B
483. Limited Study of Nesting by Stilt on the Islands of Maui, Oahu and Kauai, 1976.	W-18-R-1	R-III-C
484. Description of Waterbird Habitats as Related to Food Availability and Feeding Behavior of Endangered Waterbird Species on the Islands of Kauai and Oahu (Oahu Segment), 1976.	W-18-R-1	R-III-D
485. _____, 1977.	W-18-R-2	R-III-D

ADDITIONAL ELEPAIO CITATIONS

In addition to those issues referenced by author in the Bibliography, several short articles or field trip reports in the Hawaii Audubon Society journal, Elepaio, provided valuable information. For the most part, these citations include historical information on bird sightings. They are referenced in the report by the bibliography numbers that appear below; although they are listed here in the order of publication.

The Elepaio has been published monthly since November, 1939. There are 12 issues to each volume, beginning each year in the month of July. In most years, data on annual Christmas Counts by HAS members are published in issue 7 or 8 in the calendar year following the December count.

	<u>Vol.(Issue No.):Page</u>	<u>Year Published</u>
486.	2(9):64	1942
487.	4(7):30	1944
488.	6(11):75	1946
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490.	12(3):19	1951
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493.	20(5):33	1960
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495.	21(6):40	1960
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497.	22(1):7	1961
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499.	26(3):22	1965
500.	26(5):40	1965
501.	29(8)	1968
502.	29(8):69	1968
503.	30(7):65	1970
504.	32(3):12	1972
505.	32(3):22	1972
506.	36(9):11	1976
507.	37(1):1	1976

PERSONAL COMMUNICATION

Several persons familiar with Hawaii's waterbirds and with sites included in this survey contributed unpublished information referenced in this report. These data proved to be particularly valuable for wetlands that have not been included on semi-annual HDF&G/USF&WS surveys. These persons, with their individual affiliation, are listed below:

508.	Ahn, Mr.	Lessee, Kionakapahu Pond, Hawaii
509.	Bachman, Ronald	Wildlife Biologist (Hawaii), HDF&G
510.	Black, Gordon	Maintenance Foreman (Oahu), USF&WS
511.	Blackshear, Ray	Ranch Manager, Keaau Ranch, Hawaii
512.	Burr, Timothy	Wildlife Biologist (Oahu), HDF&G
513.	Chow, Ahin	Resident, Niumalu, Kauai
514.	Coleman, Richard.	Wildlife Biologist, USF&WS
515.	Davis, Richard	Hawaii Audubon Society
516.	Ellis, William	Resident, Niumalu, Kauai
517.	Giezentanner, Brent	Refuge Manager, USF&WS
518.	Jacinto, Luis	Irrig. Foreman, McBryde Sugar, Kauai
519.	Kridler, Eugene	Endangered Species Coordinator, USF&WS
520.	Lum, William	Cattle Rancher, Pololu Valley, Hawaii
521.	Maciolek, John	Fisheries Biologist (Kauai), USF&WS
522.	Maragos, James	Chief, Envir. Res. Div., Corps of Engineers
523.	Ohashi, Timothy	Wildlife Biologist (CETA-Oahu), HDF&G
524.	Pekelo, Noah	Oahu Dist. Enforcement Officer, HDF&G
525.	Penner, Ralph	Biologist, NURC, Kaneohe, Oahu
526.	Rice, Patricia	Landowner, Wm. Hyde Rice Ranch, Kipu, Kauai Lessee, Anahola & Wailua Jail pastures
527.	Richards, Monty	Manager, Kahua Ranch, Hawaii
528.	Scott, J. Michael	Research Biologist (Hawaii), USF&WS
529.	Shimogawa, Dwayne	Foreman, Wm. Hyde Rice Ranch, Kipu, Kauai
530.	Telfer, Thomas	Kauai District Biologist, HDF&G
531.	Uchida, Mr.	Caretaker, Keaau Ranch, Haena, Hawaii
532.	Wilcox, Carol	Landowner, Wilcox Ponds, Hanalei, Kauai
533.	Woodside, David	Statewide Non-Game Biologist, HDF&G
534.	Zeilemaker, C. Fred	former Asst. Refuge Manager(Kauai), USF&WS

APPENDIX

SUMMARY TABLES

Tables on the following pages summarize results of our survey, taken together with published and unpublished data from HDF&G, USF&WS and HAS surveys in recent years. A table for each of five islands is included, as well as an additional table with summary data on several wetlands of known value to waterbirds that were not surveyed during this project.

Separate columns are established for each of the endemic waterbirds (stilt, coot, gallinule, Koloa) and the indigenous heron. All migratory species are combined as waterfowl or shorebirds.

Current species use of an area is indicated on the tables as either feeding (F) or nesting (N). For the purposes of this summary, and in the absence of more complete data on habitat use, we will make the assumption that any species found in a particular habitat searches for food in that area. We realize that this categorization ignores the very real use of some areas as "loafing" or "roosting" habitat, but available data are simply inadequate at this point to make this distinction accurately for most species or wetlands. Evidence of nesting is taken to mean observation of nests, eggs or non-flying young. If the letters "F" or "N" are underlined (F, N), this is an indication that we did not document this type of habitat use on our survey, but it has been documented by the Principal Investigator or by other observers within the last decade. If the letters are not underlined, then the observation was made during survey, although it may only be a confirmation of earlier observations by State or Federal biologists. If either letter is in lower case ("n", "f") this is an indication that there is no documentation of habitat use, but we have reached the conclusion that either nesting or feeding probably occurs in this habitat. This conclusion is based on a knowledge of the distribution and abundance of the bird species and an evaluation of habitat.

Documented habitat use by migratory waterfowl or shorebirds is indicated by an "X". Although we observed some birds in these categories during survey, the time of year was inappropriate to accurately document habitat use of birds that are most abundant in the islands during fall and winter months. For this reason, we have relied here on previous documentation. In some areas (i.e. Molokai), previous HDF&G/USF&WS count data for several wetlands has been lumped, so there may be some minor inaccuracies. If the category is marked with a lower case "x", then we could not find documentation of habitat use, but believe that it probably occurs.

The publication Hawaii's Endangered Waterbirds (343) ranks wetland habitats by their value to endangered waterbirds. Recommendations for management are divided into "Key areas to be preserved and developed as wildlife refuges" and "areas of secondary or complementary value but worthy of retention". In the draft HWRP (346), habitat for stilt, coot and gallinule are ranked as "primary" and "secondary". The criteria for ranking in these two publications are similar, but there are some differences based on accumulation of additional data since the earlier publication and because of some changes in management priority. The rankings as they appeared in these two publications are indicated in the summary table. It should be noted

that the HWRP (346) is still in draft form at this time, and the final plan may reflect some changes in the ranking of wetland areas.

We have provided an indication of value of each habitat to waterbird species by placing an asterisk (*) in the appropriate column for those areas we believe to be currently (time of survey) of major importance to the species (or species group) on that island. This information should be interpreted in the context of statewide populations of each species, keeping in mind that the major habitats on a particular island may support only a small fraction of the statewide population of a particular species. We have also included an indication of management potential for particular species. A plus (+) sign is indicated for those habitats which, in our estimation, one can expect a significant increase in numbers for a particular endemic species through proper habitat management. Admittedly, this procedure ignores some of the very real management constraints of funding, land ownership and limited manpower. It does, however, aid in the comparative evaluation of wetland areas because it recognizes the real value of some areas lies in their potential rather than in their existing condition.

WETLAND AREAS SURVEYED

KAUAI

1. Haena Marsh
2. Wainiha Valley
3. Lumahai Valley
4. Wilcox (Kanoa) Ponds
5. Hanalei Valley
6. Kalihiwai Bog
7. Kilauea Valley
8. Anahola Valley
9. Kapaa Marsh
10. Wailua/Opaekaa Valley
11. Wailua Jail Marsh
12. Kawailoa Flats
13. Niuaulu Marsh
14. Huleia Valley
15. Kipu Reservoirs
16. Waita Reservoir
17. Pia Mill Reservoir
18. Nomilu Fishpond
19. Kalaheo Gulches
20. Hanapepe Salt Pond
21. Mana Ponds

OAHU

1. LuaLualei Reservoir
2. Kawiwi Stream
3. Dillingham Airfield
4. Haleiwa Wetlands
5. Ukoa Pond
6. Waimea River
7. Kahuku Wetlands:
 - a) Punahoolapa Pond
 - b) Punamano Pond
 - c) Kii Pond
8. Kahana Valley
9. Kaawa Valley
10. Moli/Kualoa Ponds
11. Waikane Wetland
12. Kahaluu Wetland
13. Heeia Marsh
14. Kawa Stream
15. Kaneohe M.C.A.S Ponds
16. Kawainui Marsh
17. Kaelepulu Pond
18. Paiko Lagoon
19. Kaau Crater
20. Diamond Head Crater
21. Pearl Harbor Wetlands:
 - a) East Loch Wetlands
 - b) Pearl Harbor NWR, Waiawa Unit
 - c) Waipio Peninsula Ponds
 - d) Honouliuli Ponds
 - e) Pearl Harbor NWR,
Honouliuli Unit

MOLOKAI

1. Kaumana Fishpond
2. Waiakane Fishpond
3. Pakanaka Fishpond
(and salt flats)
4. Kaluaapuhi Fishpond
5. Kaunakakai Pier Area
(and Sewage Pond)
6. Kalokoeli Fishpond
7. Alii Fishpond
8. Kakahaia Fishpond
9. Pahiomu Fishpond
10. Kamahuehue Fishpond
11. Kamalo Fishpond
12. Keawanui Fishpond
13. Ualapue Fishpond

MAUI

1. Kealia Pond
2. Launiupoko Pt. Reservoir
3. Crater/Waihukuli Reservoirs
4. Waihee Marsh
5. Waiehu Pt. Marsh
6. Paukukalo Marsh
7. Kanaha Pond
8. Kapalaalaea Reservoir
9. Papaaea Reservoir
10. Keanae Valley

HAWAII

1. Waiakea/Mohouli Ponds
2. Lokoaka/Kionakapahu Fishponds
3. Keaau Ranch Fishpond
4. Kapoho Fishpond
5. Punaluu/Ninole Ponds
6. Kiilae Forest Bog
7. Aimakapa/Kaloko Fishponds
8. Opaepala Pond
9. Kiholo Fishpond
10. Kahua Ranch Ponds
11. Pololu Valley
12. Waimanu Valley
13. Waipio Valley

TABLE 10: WATERBIRDS IN WETLANDS SURVEYED ON KAUAI

Wetland Site	Stilt	Coot	Gallinule	Koioa	Heron	Migratory Waterfowl	Migratory Shorebirds	HWRP	HEW
1) Haena Marsh									
2) Wainiha Estrary	F	F	nF	nF	nF	X	X	---	second.
3) Lumahai Estuary	F	F	<u>F</u>	<u>NF</u>	nF	X	X	prim.	second.
4) Wilcox Ponds	f	F**	nF**	<u>NF</u>	<u>F</u>	X	X	prim.	
5) Hanalei Valley	NF**	F**	NF**	<u>NF**</u>	nF	X	X	prim.	key
6) Kalihiwai Bog				nF	f				
7) Kilauea Estuary	f	nF	F	nF	nF	X	X		
8) Anahola Estuary	f	F	F	F	F	x	X		
9) Kapaa Marsh	f	f	F	f	F	x	x		
10) Wailua/Opaekaa Val.	F+	F**	NF**	<u>NF+</u>	nF	X	X	second.	key
11) Wailua Jail Marsh				F	F	x	X		
12) Kawaihoa Flats	F	F	f	nF	<u>F</u>	x	X		
13) Niualu Marsh		f	NF+	<u>NF</u>	<u>F</u>	X	X		
14) Huleia Valley	<u>F+</u>	F+	<u>NF+</u>	<u>NF</u>	nF	X	X	second.	key
15) Kipu Reservoirs	<u>NF+</u>	<u>NF**</u>	n <u>F+</u>	<u>NF**</u>	nF	X	X		
16) Waita Reservoir	F	nF*	nF	nF	nF	X	X	prim.	second.
17) Pia Mill Reservoir		nF	<u>F</u>	<u>F</u>	F	X	X		
18) Nomilu Fishpond	f				f		x		

TABLE 10 : (cont.) WATERBIRDS IN WETLANDS SURVEYED ON KAUAI

Wetland Site	Stilt	Coot	Gallinule	Koioa	Heron	Migratory Waterfowl	Migratory Shorebirds	HWRP	HEW
19) Kalaheo Gulches	F			F	F		X		
20) Hanapepe Salt Pond	F+	F	<u>F</u>	<u>F</u>	F	X	X	----	second.
21) Mana Ponds	NF**	F+	F+	<u>NF**</u>	F	X	X	prim.	-----

TABLE 11: WATERBIRDS IN WETLANDS SURVEYED ON OAHU

Wetland Site	Stilt	Coot	Gallinule	Koioa	Heron	Waterfowl	Shorebirds	HWRP	HEW
1) Luaualei Res.					f	x			
2) Kawiwi Stream	f					x	X		
3) Dillingham Airfield					F		X		
4) Haleiwa Wetlands	<u>F</u>	nF	<u>NF*</u>		F	X	X		
5) Ukoa Pond	F+	<u>nF+</u>	nF**+		F	X	X	prim.	---
6) Waimea River		<u>F</u>		<u>F</u>	F	X	X		
7) Kahuku Wetlands:									
a) Punahooiapa Pond	F	nF**+	nF+	nF+	F*	X	X	second.	key
b) Punamano Pond	F+	<u>NF**+</u>	nF+		<u>NF*</u>	X*	X*	prim.	key
c) Kii Pond	<u>NF+</u>	<u>NF+</u>	<u>NF</u>		<u>F*</u>	X	X	prim.	key
8) Kahana Valley	<u>F</u>	F	F		nF	X	X	second.	
9) Kaawa Valley			F		<u>F</u>				
10) Moli'i/Kualoa Ponds	F	F	nF		nF*	X	X	second	second
11) Waikane Wetland		f	f		F				
12) Kaha'ulu Wetland			F		f				
13) Heeia Marsh		F	nF**+		<u>NF*</u>	X	X	second	
14) Kawa Stream					F	x	x		
15) Kaneohe M.C.A.S.	NF**+			NF	<u>NF*</u>	X	X*	prim.	key
16) Kawainui Marsh	NF+	NF**+	NF**+	NF**+	nF*	X*	X	prim.	key

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TABLE 11: WATERBIRDS IN WETLANDS SURVEYED ON OAHU (cont.)

Wetland Site	Stilt	Coot	Gallinule	Koioa	Heron	Migratory Waterfowl	Migratory Shorebirds	HWRP	HEW
17) Kaelepu Pond	F	F	F	<u>F</u>	F	X	X		
18) Paiko Lagoon	F+				F	X	X	second.	second.
19) Kaau Crater	<u>F</u>	F		F	f		x		
20) Diamond Head Crater				<u>F</u>	f				
21) Pearl Harbor									
a) East Loch	<u>F</u>	f			<u>F</u>	X	X	prim.	key
b) Pearl Harbor									
NWR Waiawa Unit	NF*+	F	F		F	X	X*	prim.	key
c) Waipio Peninsula	<u>NF*+</u>	<u>F*+</u>	<u>F</u>	<u>F</u>	<u>NF*</u>	X*	X*	prim.	key
d) Honouliuli Ponds	<u>F</u>	NF+	NF+		<u>F</u>	X	X	prim.	key
e) Pearl Harbor NWR									
Honouliuli Unit	F*+	F+	F	<u>F</u>	F	X	X	prim.	key

TABLE 12 : WATERBIRDS IN WETLANDS SURVEYED ON MOLOKAI

Wetland Site	Stilt	Coot	Gallinule	Koioa	Heron	Migratory Waterfowl	Migratory Shorebirds	HWRP	HEW
1) Kaumana Fishpond	f						X		
2) Waiakane Fishpond	f				F		X		
3) Pakanaka Fishpond	f				f	x	X		
Palaau Salt Flats	<u>F</u>				f	x	X		
4) Kaluaapuhi Fishpond	<u>F</u> +	nF**	<u>F</u>		nF*	X*	X	second.	second.
5) Kaunakakai Pier Area (and Sewage Pond)	F**	<u>F</u>			F*	X*	X	Second.	-----
6) Kalokueli Fishpond	f				nF*	x	X		
7) Alii Fishpond	f				nF	x	X		
8) Kakahaia Fishpond	<u>F</u>	NF**			nF*	X*	X	prim.	key
9) Pahiomu Fishpond	f				f	x	X		
10) Kamahuehue Fishpond	f				f	x	X		
11) Kamalo Fishpond	F				f		X		
12) Keawanui Fishpond	f				f	x	X		
13) Ualapue Fishpond	f				f	x	X		

Note: No gallinule reported on Molokai since 1973 (ref. 523)

TABLE 13: WATERBIRDS IN WETLANDS SURVEYED ON MAUI

Wetland Site	Stilt	Coot	Gallinule	Koioa	Heron	Migratory Waterfowl	Migratory Shorebirds	HWRP	HEW
1) Kealia Pond	<u>NF**</u>	NF**			NF*	X	X	prim.	key
2) Launiupoko Pt. Res.									
3) Crater/Wainukūi Res.	f				F*	X			
4) Waihee Marsh	f				f	X	x		
5) Waiehu Pt. Marsh							x		
6) Paukukalo Marsh					F		x		
7) Kanaha Pond	NF**	NF**			nF*	X	X	prim.	key
8) Kapalaalaea Reservoir	f				F	X	X		
9) Papaaea Reservoir	f				F	X	x		
10) Keanae Valley			<u>F?</u>		F	X	X		

TABLE 14: WATERBIRDS IN WETLANDS SURVEYED ON HAWAII

Wetland Site	Stilt	Coot	Gallinule	Koioa	Heron	Migratory Waterfowl	Migratory Shorebirds	HWRP	HEW
1) Waiakea/Mohouli Ponds		NF*			F*	X*	X	second	----
2) Lokoaka/Kionakapahu		<u>NF</u>			nF+	X*	X	second.	second
3) Keaau Ranch Fishpond		<u>NF</u>			nF	X*			
4) Kapoho Fishpond					F	X	X		
5) Punaluu/Ninole Ponds		f			<u>F</u>	X	X		
6) Kiilae Forest Bog					<u>F</u>				
7) Aimakapa	<u>NF*</u>	NF*			F	X*	X	prim.	key
8) Opaepa Pond	NF*	NF*		F	F	X*	X*	prim.	key
9) Kiholo Fishpond					<u>F</u>	X	X		
10) Kahua Ranch Ponds				<u>NF*</u>		X	X*		
11) Poiohu Valley		F		<u>nF</u>	nF	X	X	second.	second.
12) Waimanu Valley		f		nf	<u>F</u>	x	X	second.	second.
13) Waipio Valley		<u>F?</u>		<u>nF</u>	nF*	X	X	second.	second.

TABLE 15: WETLANDS OF KNOWN VALUE TO WATERBIRDS NOT INCLUDED ON SURVEY

Wetland Site	Stilt	Coot	Gallinule	Koloa	Heron	Migratory Waterfowl	Migratory Shorebirds	HWRP	HEW
KAUAI									
PuukaEle Res.	<u>f</u>	<u>NF*</u>	<u>F</u>	<u>f</u>	<u>f</u>	X	X	prim.	---
Waipa Valley	<u>F</u>	<u>F</u>	<u>F</u>	<u>nf</u>	<u>F</u>	X	X	second	---
Sugar cane settling basins	<u>NF**</u>	<u>F*</u>	<u>F</u>	<u>F</u>	<u>F</u>	X	X	second	second
Kekaha Pastures	<u>F**</u>	<u>F</u>		<u>F</u>	<u>F</u>	X	X		
Other Reservoirs (60+)	<u>F</u>	<u>F*</u>	<u>F</u>	<u>nF</u>	<u>nF</u>	X	X		
OAHU									
Keehi Lagoon	<u>F*</u>				<u>F</u>	X	X	second.	---
Nuuanu Reservoir		<u>nF*</u>	<u>nF</u>	<u>F</u>	<u>F</u>	X	X	second	second
Bellows AFS	<u>F</u>	<u>F</u>	<u>F</u>		<u>F</u>	X	X		second
Salt Lake	<u>F</u>	<u>F</u>		<u>F</u>	<u>F</u>	X	X	second	
Lunalualei N.A.D. (Niulii Res.)	<u>F</u>	<u>nF</u>	<u>nF</u>	<u>F</u>	<u>F</u>	X	X		
MOLOKAI									
Other Fishponds	<u>F</u>	<u>F</u>			<u>nF</u>	X	X		
MAUI									
Other Reservoirs	<u>F*</u>	<u>F</u>			<u>F</u>	X	X	second	---
HAWAII									
NIIHAU									
Halalii, Halulu & Nonopapa lakes	<u>nF**</u>	<u>nF**</u>		<u>F</u>	<u>F</u>	X	X	prim.	prim.

HDF&G/USF&WS WATERBIRD COUNT DATA

Beginning in 1955, biologists within the Territorial Board of Commissioners of Agriculture and Forestry initiated annual winter counts of waterbirds under a project entitled "Ecological Investigation of Migratory Game Birds." Count data were recorded on endemic waterbirds as well. With statehood, and reorganization of government, this task was taken over by the Division of Fish and Game within the Department of Land and Natural Resources. Summer waterbird surveys were initiated on a statewide basis in 1968. U.S. Fish and Wildlife Service biologists cooperate on these surveys, which are typically held on single days in January and in July or August. The number of wetland sites visited have increased nearly every year. Currently more than 250 sites are counted, with over half of these on the island of Kauai. Nearly half of the statewide list of sites are reservoirs, most of which are visited on Kauai and Maui.

Data generated from this long series of repetitive counts have contributed a great deal to our understanding of the abundance and distribution of waterbirds in the State. However, some problems inherent in the census program have combined to limit the accuracy and utility of the data, for some species and sites more than others. Some of these problems include: (1) variation in the list of sites surveyed, (2) variations in individual site coverage and methods of survey, (3) variations in competency of observers, (4) scheduling of surveys with little or no respect to weather, tidal patterns, time of day, etc., (5) inconsistencies in methods of recording data, (6) inadequate documentation of uncommon or rare species, or other unusual observations, and (7) inadequate documentation of types of habitat use by various species. The accuracy of the data varies considerably when different species are compared. It appears that counts are most accurate for stilt, coots and migratory waterfowl. Census data are probably least accurate for gallinule because of their secretive habits, and Koloa, because of their wide distribution and adaptability to a wide range of natural and artificial wetlands. State and Federal biologists have identified the need to refine census techniques and are working together towards that goal.

Tables 16-19 provide a summary of census data for stilt, coots, gallinule, migratory waterfowl and migratory shorebirds. Data here on migratory species goes back only to 1968. These data are useful in interpretation of habitat use data provided in Summary Tables 10-15. A clear picture of the relationship between populations of each species on different islands awaits the results of banding and color marking studies now underway in a cooperative HDF&G/USF&WS project.

NUMBER OF HAWAIIAN STILTS RECORDED ON
ANNUAL CENSUS IN JANUARY, 1956-77

ISLAND	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	AVERAGE	
Niihau	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	174	25	100
Kauai	6	6	-	12	14	8	-	19	55	18	7	20	38	49	12	51	39	74	0	37	117	372	43	
Oahu	163	272	549	533	*	134	175	356	485	184	242	209	175	162	322	362	342	509	107	110	249	738	304	
Molokai	-	-	-	-	7	13	7	-	9	-	-	-	-	-	-	-	-	6	-	6	13	24	4	
Maui	169	190	159	211	232	155	282	170	164	162	253	188	226	171	207	189	274	352	245	340	335	302	226	
Hawaii	-	-	-	-	-	1	-	11	21	27	28	19	47	35	24	27	27	24	20	16	22	15	17	
TOTALS	338	468	708	756	253	311	464	556	734	391	530	436	486	417	565	629	682	965	372	509	910	1476	589	

*NOT CENSUSED

NUMBER OF HAWAIIAN STILTS RECORDED ON
ANNUAL CENSUS IN JULY/AUGUST, 1968-76

ISLAND	1968	1969	1970	1971	1972	1973	1974	1975	1976	AVERAGE
Niihau	*	155	128	48	94	*	51	37	25	77
Kauai	92	109	54	78	101	120	158	381	372	163
Oahu	565	785	491	369	511	469	427	507	738	540
Molokai	*	-	18	-	-	*	5	11	24	8
Maui	611	440	469	426	644	216	552	523	302	465
Hawaii	19	24	27	19	16	17	22	17	15	20
TOTALS	1287	1513	1187	940	1366	822	1215	1476	1476	1254

*NOT CENSUSED

TABLE 16.

excerpted from: Hawaiian Waterbirds Recovery Plan, Draft 2 (August 1977).

NUMBER OF HAWAIIAN COOTS RECORDED ON
ANNUAL CENSUS IN JANUARY, 1956-77

ISLAND	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	AVERAGE	
Niihau	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	160	9	85
Kauai	33	11	5	17	17	40	44	162	75	6	23	26	38	77	214	111	85	295	35	175	395	1919	173	
Oahu	528	338	449	822	*	717	12	169	98	112	77	106	64	15	130	84	132	122	41	83	148	148	209	
Molokai	-	-	20	33	27	21	59	48	78	-	4	14	-	-	28	-	24	-	-	27	-	38	19	
Maui	177	273	256	170	188	149	205	108	79	53	75	80	104	122	78	76	161	114	63	151	177	154	137	
Hawaii	-	-	4	63	26	91	51	49	23	46	39	-	47	20	36	28	53	57	49	89	76	62	41	
TOTALS	738	622	734	1105	258	1018	371	536	353	217	218	226	253	234	486	299	455	588	188	525	956	2330	578	

*NOT CENSUSED

NUMBER OF HAWAIIAN COOTS RECORDED ON
ANNUAL CENSUS IN JULY/AUGUST, 1968-1976

ISLAND	1968	1969	1970	1971	1972	1973	1974	1975	1976	AVERAGE
Niihau	*	145	*	28	748	*	40	155	91	201
Kauai	122	1058	223	117	206	214	241	1727	1510	602
Oahu	164	164	264	292	86	97	56	165	143	159
Molokai	*	48	13	20	28	*	27	32	34	29
Maui	*	232	171	176	232	71	144	160	123	164
Hawaii	*	20	39	55	52	30	84	130	75	61
TOTALS	286	1667	710	688	1352	412	592	2369	1976	1117

*NOT CENSUSED

Table 17.

excerpted from: Hawaiian Waterbirds Recovery Plan, Draft 2 (August 1977).

NUMBER OF HAWAIIAN GALLINULES RECORDED ON
ANNUAL CENSUS IN JANUARY, 1956-1977

ISLAND	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	AVERAGE
Kauai	2	*	2	10	4	10	12	10	8	-	17	7	44	50	26	10	-	7	1	38	92	113	22
Oahu	-	*	-	-	*	-	-	1	3	25	21	6	13	5	22	12	15	1	5	10	17	26	9
Molokai	-	*	-	-	-	2	8	19	17	-	-	3	-	-	-	-	-	-	-	-	-	-	2
TOTALS	2	*	2	10	4	12	20	30	28	25	38	16	57	55	48	22	15	8	6	48	109	139	33

*NOT CENSUSED

NUMBER OF HAWAIIAN GALLINULES RECORDED
ON ANNUAL CENSUS IN JULY/AUGUST, 1968-1976

ISLAND	1968	1969	1970	1971	1972	1973	1974	1975	1976	AVERAGE
Kauai	24	*	15	33	1	16	14	88	68	32
Oahu	21	*	12	7	3	13	13	15	8	12
Molokai	-	9	-	-	-	-	-	-	-	1
TOTALS	45	9	27	40	4	29	27	103	76	40

*NOT CENSUSED

Table 18.

excerpted from: Hawaiian Waterbirds Recovery Plan, Draft 2 (August 1977).

Table 19. Count data from HDF&G/USF&WS semi-annual waterbird surveys, 1968-1976.

	1968		1969		1970		1971		1972		1973		1974		1975		1976
	Jan	Jul	Jan	Jul	Jan	Aug	Jan	Jul	Jan	Aug	Jan	Jun	Jan	Aug	Jan	Aug	Jan
Migratory Shorebirds (a)																	
Niihau	*	*	*	*	*	90	*	40	*	28	*	*	*	40	*	100	219
Kauai	212	2	163	26	101	33	64	4	71	14	116	41	19	46	72	31	406
Oahu	1303	168	785	64	1196	552	852	88	2093	201	1871	408	1379	436	1705	352	2200
Molokai	27	*	146	0	29	2	0	0	41	0	47	*	*	5	74	32	22
Maui	71	*	39	*	72	283	16	94	227	214	252	56	147	180	146	193	97
Hawaii	457	0	107	0	90	0	333	11	158	0	282	5	59	34	74	19	132
Statewide Total	2070	170	1240	90	1488	960	1265	237	2590	457	2568	510	1604	741	2071	727	3076
Migratory Ducks (b)																	
Niihau	*	*	*	*	*	0	*	0	*	0	*	*	*	0	*	0	55
Kauai	162	0	21	0	393	0	134	0	421	0	568	0	33	0	117	0	451
Oahu	175	0	69	0	283	4	289	0	262	0	291	0	72	2	245	0	763
Molokai	36	*	0	0	38	14	0	0	34	0	16	0	*	0	169	0	61
Maui	938	*	373	*	936	15	1529	8	1881	3	1829	10	815	0	866	3	835
Hawaii	131	0	94	0	330	0	131	0	221	0	260	6	119	0	171	0	547
Statewide Total	1442	0	557	0	1980	33	2083	8	2819	3	2964	16	1039	2	1568	3	2712

* not censused.

(a) includes only Golden Plover, Ruddy Turnstone, Wandering Tattler and Sanderling.

(b) includes all recorded species.

GLOSSARY

This glossary contains definitions of 115 selected terms, phrases and abbreviations that are used in this report. For words with a broad range of meaning, the definitions here reflect the manner in which these words are used in this report. For some terms, the reader is referred to specific sections of the text for a more complete definition.

Anadromous fishes - those species of fish which go up rivers or streams to spawn.

Aquaculture - management of natural or man-made habitat for the cultivation of certain aquatic animals or plants for human use or consumption.

Aquatic - growing or living in or upon water.

Archipelago - refers to the entire Hawaiian Islands' chain (from Hawaii to Kure) as opposed to the main islands.

Bog - a wetland created by impeded drainage; hummocks of mosses and dwarfed tree species are characteristic.

Brackish water - water of intermediate salinity between salt water and fresh water.

Brood - the young (collectively) of a nesting pair of birds.

Browse - to feed on vegetation (in the case of waterbirds, may also include feeding on algae or organisms attached to plants).

Captive reared - birds that are hand raised in captivity, and in the case of Koloa, are intended for release into the wild as part of a population restoration program.

Christmas Count - annual bird counts conducted at Christmas time by members of the Hawaii Audubon Society.

Critical habitat - as provided for in the Endangered Species Act of 1973 (P.L. 93-205) and defined in the Endangered Species Technical Bulletin (Vol. 1, No.2) as "the area of land, water, and airspace required for the normal needs and survival of a species." Unlike other evaluations of habitat, "critical habitat" is designated by the USF&WS after following a standard procedure of proposal and review. Once an area is designated "critical habitat" for an endangered species, then section 7 of the Act (relating to actions of Federal agencies) is applicable.

- Dabbling duck - refers to a group of duck species that feed at or near the surface of the water. They may tip for food but rarely, if ever, dive. In Hawaii, this includes Mallards, Wigeon, Teal, Pintails, and Northern Shovelers as well as the native Koloa.
- Depredation - in the context of this report, refers to the act of destroying agricultural crops as a source of food or nesting material.
- Distraction display - in the case of the Hawaiian Stilt, refers to a broken wing act in which an adult bird feigns injury in response to the approach of a potential predator. Presumably this serves to distract attention away from a nest or young birds.
- Diving duck - refers to a group of duck species which dive for their food, in contrast to dabbling ducks.
- Downy - growth stage of a young bird prior to the development of adult feathers, characterized by the presence of down feathers.
- Dredged material - "material that is excavated or dredged from waters of the United States" (as defined in the Federal Register, Vol. 42, No. 138). See pg. 19.
- Ecological succession - the orderly and progressive replacement of one ecological community by another until a relatively stable community occupies an area. An example is the natural development of a pond into a marsh and eventually into a swamp or forest through gradual accumulation of soil and change in vegetation.
- Elepaio - the journal of the Hawaii Audubon Society, issued monthly since November, 1939.
- Emergent vegetation - plant species growing on exposed or submerged soils and with leaves and flowers of mature individuals erect in the air.
- Encroaching vegetation - as used in this report, refers to plants which are gradually diminishing the size of a wetland by growing over the surface or into the edges of open water.
- Endangered species - in imminent danger of extinction, as determined by State and Federal authorities. Criteria include the size of the population, population trends, and the extent and vulnerability of the habitat. The Federal Endangered Species Act of 1973 (P.L. 93-205) defines and endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range". The State of Hawaii has its own endangered species law, which includes all species covered by Federal law, plus some individual island populations of species that are not included on the Federal list.

- Endemic - unique to a given area and not occurring naturally elsewhere.
- Ephemeral - not permanent; in this report refers to those habitats that are "wetlands" only temporarily after periods of heavy rainfall or runoff.
- Essential habitat - used in the draft HWRP(346) to describe areas believed to be necessary for the survival of Hawaiian Stilt, Coot and Gallinule as individual species.
- Estuary - the region of a stream drainage where fresh water mixes with salt water of the ocean, characterized by water of variable salinity depending on effects of runoff and tidal influence.
- Evapotranspiration - the total water loss from the soil, including that by direct evaporation and that by transpiration from the surface of plants.
- Exotic - not indigeonous; plant or animal species that arrived in Hawaii with the assistance of man.
- Extant - still living; not extinct.
- Extinct - no longer extant; the term has been applied loosely (and incorrectly) to any population of a species that is no longer present within a portion (such as an island) of the range of the species as a whole. Used correctly, the term includes only distinct taxa (i.e. species, subspecies), not populations.
- Fallow - left uncultivated or unplanted.
- Fauna - animal life.
- Feral - animals from domestic stock which have returned to or have been released into the wild (and their descendants).
- Fill material - "any material used for the primary purpose of replacing an aquatic area with dry land or of changing the bottom elevation of a water body." (as defined in the Fed. Reg., Vol.42, No.138). See pg. 19.
- Fishpond - a pond which was constructed by the early Hawaiians for purposes of raising any of a number of fish species for food.
- Floating leaved vegetation - plant species growing on submerged soils and with leaves floating on the waters' surface; some species may also regularly have submerged leaves and some produce aerial leaves.
- Floating nest - a nest constructed of vegetative material which floats on the water surface; in many cases, such nests are actually attached by vegetation to the substrate, and are not truly "floating".

Flora - plant life

Flyway - route regularly used by migratory birds flying to and from breeding grounds.

Frontal shield - the fleshy protuberance extending onto the forehead from the upper half of the bill on coots and gallinule.

F.W.P.C.A. - Federal Water Pollution Control Act.

Gastropod mollusc - a mollusc of the class Gastropoda (i.e. snails, limpets, etc.)

Habitat - the environment in which an animal or plant lives, distinct from other habitat by a variety of biological and physical characteristics.

Habitat management - manipulation of habitat conditions to improve the suitability of the area for a species. This may involve improvement of conditions for feeding and/or nesting. In the case of wetland birds, varying requirements of different species will require differences in habitat management techniques.

H.A.S. - Hawaii Audubon Society

H.D.F. & G. - Hawaii Division of Fish and Game, of the Department of Land and Natural Resources, State of Hawaii.

Heronry - heron nesting or roosting area.

H.W.R.P. - Hawaiian Waterbirds Recovery Plan (reference 346).

Indigenous - occurring naturally in a given area without the assistance of man (includes migratory species).

Interbreeding - breeding of two animals of different taxa (i.e. subspecies, species, etc.).

Introduced - occurring in a given area by the intentional or accidental intervention of man. (synonymous with "exotic").

Juvenile - in this report, refers to a young bird that has developed adult feathers (teleoptiles) but is not capable of breeding.

K.M.C.A.S. - Kaneohe Marine Corps Air Station, located on Mokapu Peninsula, Oahu.

Key area - term used in the publication Hawaii's Endangered Waterbirds (343) to denote areas recommended to be preserved and fully developed as a refuge to insure the future of Hawaii's endangered waterbirds.

Limnology - the science that studies the biological, physical and chemical aspects of fresh water lakes, ponds and streams.

- Loafing habitat - in this report, refers to wetlands or portions of wetlands where waterbirds rest or roost; typically found close to feeding or nesting areas.
- Macrofauna - larger animal life, as opposed to microscopic forms.
- Main islands - refers to the eight major islands of the Hawaiian Chain, from Hawaii to Niihau, with their offshore islets.
- Marginal habitat - refers to wetlands that are of minor significance to a species or group of waterbird species; for one or more reasons the habitat does not support many waterbirds.
- Marsh - a wetland with vegetation dominated by grasses, sedges and rushes, and with few, if any, woody shrubs or trees.
- Migratory - breeding in one area and wintering in another; refers here to waterfowl and shorebirds that breed in arctic or subarctic regions and winter in Hawaii. May also include resident seabirds that nest in Hawaii and migrate away from the Islands during the non-breeding season.
- Mixohaline - brackish water; an area where waters of different salinities are mixed.
- Mollusc - member of the large invertebrate phylum, Mollusca (chitons, oysters, clams, mussels, snails, slugs, squid, etc.).
- Morphology - form and structure of animals or plants.
- Mortality - death; referred to as a measure of the proportion of deaths to the population of an area.
- Native - indigenous; refers here to animal or plant species that are established in Hawaii (as breeding or migratory species) without the aid of man.
- Nesting islet - refers to a natural or man-made islet, surrounded by water, used as a nesting site by waterbirds; artificial islets have been constructed in some wetlands in Hawaii to provide predator-free nesting areas for waterbirds, particularly Hawaiian Stilt.
- Nursery pond - small man-made ponds often constructed in conjunction with larger fishponds by early Hawaiians and in modern aquaculture; used for initial stages of rearing young fish.
- Nutrient - elements and compounds necessary for growth and reproduction of plants and animals, which through biogeochemical cycles in the ecosystem. Macronutrients include calcium, magnesium, phosphorus, potassium and sulfur.
- N.W.R. - National Wildlife Refuge (established and managed by USF&WS).

Obligate species - one which is dependent upon a specific kind of environment for at least part of its life cycle.

Pelagic - of the open sea or ocean surface, as distinguished from coastal waters.

Perennial stream - one which flows throughout the year.

Phytoplankton - microscopic aquatic plant life.

Plumage - a bird's feathers, collectively.

Poaching - taking illegally.

Prawn - any of a number of related edible, shrimplike crustaceans.

Prawn pond - an aquaculture facility constructed or maintained for the purpose of raising prawns.

Predator - an animal which lives by capturing and feeding upon other animals.

Primary area - designation used in the draft HWRP (346) to denote an area that provides all of the necessities for completion of the annual life cycle for significant numbers of stilt, coots and gallinule in the same geographical area or areas that support large numbers of these species at one time or another during the year, during breeding or non-breeding periods.

Proximal - situated nearest the center of the body or nearest the point of attachment of a muscle, limb, etc.

Redd - a circular depression in a pond or stream bottom which has been scooped out by a male tilapia fish for use as a spawning place.

Reservoir - a water impoundment intentionally created by man for the primary purpose of storing water for agricultural or domestic use.

Rookery - a breeding place or colony of gregarious birds such as herons or egrets.

Roost - to sit, rest, sleep, etc. on a perch.

Seabird - see pg. 48.

Secondary area - designation used in the draft HWRP (346) and the publication Hawaii's Endangered Waterbirds (343) which are of less importance to endangered species than are primary areas, but are of complementary value and worthy of preservation.

Section 404 - a section of the Federal Water Pollution Control Act amendments of 1972 pertaining to deposition of dredged or fill material in wetlands. See pg. 1.

- Semi-annual survey - a census of waterbirds in selected wetlands conducted semi-annually; usually conducted statewide on one day in January and one day in July or August, by HDF&G and USF&WS biologists.
- Settling basin - water impoundments created to allow suspended waste material or silt to settle to the bottom before the water is allowed to run into the ocean.
- Scat - fecal remains, usually of mammals; useful in detecting prior presence of different mammal species.
- Shorebird - see pg. 47.
- Sign - tracks, feces, pellets, scats, rootings, or other evidence of an animal's presence.
- Siltation - to fill or choke with silt.
- Species - the fundamental biological classification consisting of a number of animals or plants which have a high degree of similarity, can generally breed successfully only among themselves, and show persistent differences from members of allied species.
- Speculum - a distinctive patch of color on the wings of certain birds, especially ducks.
- Stream channelization - alteration of natural stream course and pattern of flow normally by construction of a concrete channel, designed to reroute the flow and/or to control flood waters.
- Submergent vegetation - plant species growing on submerged soils and with foliage entirely underwater.
- Subspecies - a natural subdivision of a species that exhibits small but persistent morphological differences from other subdivisions of the same species, living in different geographical regions (i.e. islands).
- Substrate - bottom; in a wetland the material underlying water, supporting plant and animal life.
- Swamp - a wetland with vegetation generally dominated by trees or woody shrubs.
- Taro field - as used in this report, refers to a water impoundment constructed for the planting of taro (Colocasia esculenta), as distinct from dryland forms of taro.
- Tarsometatarsus - the large bone in the lower part of a bird's leg, connecting the tibia and the toes.
- Territory - a particular area occupied by an animal or group of animals, usually for nesting, breeding and feeding, that is defended against intruders.

Threatened species - as defined by the Federal Endangered Species Act of 1973 (P.L. 93-205), "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Tilapia - the genus (and common name) of any one of four species of fresh water fish introduced to Hawaii as early as 1951. Populations of tilapia may reach pest proportions in localized areas. Compete with more desirable species (native and exotic). Male constructs depressions called redds in the mud bottom, into which the female lays her eggs.

Turbid - muddy or cloudy from having sediment introduced or stirred up in water.

U.S.F. & W.S. - United States Fish and Wildlife Service (formerly Bureau of Sport Fisheries and Wildlife), Department of the Interior.

Waterbird - see pg. 16.

Waterbird productivity - measure of the addition of young birds to the population through successful breeding and rearing of young.

Water diversion - changing the natural course of a stream or rainwater runoff.

Waterfowl - see pg. 39.

Wetland - see pg. 11.

Zooplankton - microscopic aquatic animal life.

PLANTS REFERRED TO IN REPORT TEXT

<u>Scientific Name and Family</u>	<u>Common Name(s)</u>	<u>Hawaiian Name(s)</u>
FILICINAE:		
DICKSONIACEAE: Tree Fern Family		
* <u>Cibotium</u> sp.	Hawaiian tree fern	hapu'u
GLEICHENIACEAE: Vinefern Family		
+ <u>Dicranopteris linearis</u> (Burm.)Und.	False staghorn fern	uluhe
SALVINIACEAE: Water Fern Family		
<u>Azolla filiculoides</u> Lam.	Azolla;waterfern	
GYMNOSPERMAE:		
ARAUCARIACEAE: Araucaria Family		
<u>Araucaria heterophylla</u> (Salisb.) Franco	Norfolk Island pine	
MONOCOTYLEDONAE:		
ALISMATACEAE: Water Plantain Fam.		
<u>Sagittaria sagittaeifolia</u> L.	Arrowhead	
ARACEAE: Arum Family		
<u>Alocasia macrorrhiza</u> (L.) Sweet		'ape; apii
<u>Colocasia esculenta</u> (L.) Schott	Taro	
<u>Pistia stratiotes</u> L.	Water Lettuce	
CYPERACEAE:		
+ <u>Cladium leptostachyum</u> Nees & Meyen	Native sawgrass	'uki
<u>Cyperus alternifolius</u> L.	Umbrella sedge	'ahu'awa-haoie; pu'uka'a-haoie
<u>Cyperus papyrus</u> L.	Papyrus	kaluhā
<u>Eleocharis</u> sp.	Spike rush	
<u>Scirpus</u> sp.	Bulrush	
COMMELINACEAE: Spiderwort Family		
<u>Commelina diffusa</u> Burm. f.	Dayflower	honohono
ELODEACEAE - Waterweed Family		
<u>Egeria densa</u> Planch.	Waterweed; water thyme	

PLANTS (continued)

<u>Scientific Name and Family</u>	<u>Common Name(s)</u>	<u>Hawaiian Name(s)</u>
MONOCOTYLEDONAE: (continued)		
GRAMINEAE: Grass Family		
<u>Brachiaria mutica</u> (Forsk.) Stapf	California Grass	
<u>Coix lacryma-jobi</u> L.	Job's tears	'ohe pā 'ohe 'ohe; pūpū-kōlea
<u>Oryza sativa</u> L.	Rice	laiki
<u>Panicum repens</u> L.	Torpedo grass	
<u>Paspalum vaginatum</u> Sw.	Seashore paspalum; biscuit grass	
<u>Pennisetum clandestinum</u> Chiov.	Kikuyu grass	
<u>Saccharum officinarum</u> L.	Sugar cane	kō
LEMNACEAE: Duckweed Family		
<u>Spirodela polyrrhiza</u> (L.) Schleid.	Greater duckweed	
PALMAE: Palm Family		
<u>Cocos nucifera</u> L.	Coconut, cocopalm	niu
PANDANACEAE: Screwpine Family		
+ <u>Pandanus odoratissimus</u> L.f.	Pandanus; screwpine	hala
PONTEDERIACEAE: Pickerelweed Fam.		
<u>Eichornia crassipes</u> (Mart.) Solms	Water hyacinth	
POTAMOGETONACEAE: Pondweed Fam.		
<u>Potamogeton foliosus</u> Raf.	Leafy pondweed	
RUPPIACEAE: Ruppia Family		
+ <u>Ruppia maritima</u> L.	Widgeon grass	
TYPHACEAE: Cattail Family		
<u>Typha angustata</u> Bory & Chaubord	Cattail	
DICOTYLEDONAE:		
AIZOACEAE: Carpetweed Family		
+ <u>Sesuvium portulacastrum</u> (L.) L.	Sea purslane	'akulikuli
ANACARDIACEAE: Mango Family		
<u>Mangifera indica</u> L.	Mango	manakō
<u>Schinus terebinthifolius</u> Raddi	Christmas berry	nani-o-hilo; wilelaiki
BATIDACEAE: Batis Family		
<u>Batis maritima</u> L.	Pickleweed; saltwort	'akulikuli-kai

PLANTS (continued)

<u>Scientific Name and Family</u>	<u>Common Name(s)</u>	<u>Hawaiian Name(s)</u>
DICOTYLEDONAE:(continued)		
CASUARINACEAE: Casuarina Family <u>Casuarina equisetifolia</u> Stickm.	Ironwood	
COMBRETACEAE: Combretum Family <u>Terminalia catappa</u> L.	False Kamani; tropical almond	kamani-haole; kamani-'ula
COMPOSITAE: Sunflower Family <u>Pluchea</u> sp.	Pluchea	
CONVOLVULACEAE: Morning Glory Fam. <u>Ipomoea</u> sp.	Morning glory	
CRUCIFERAE: Mustard Family <u>Nasturtium microphyllum</u> Reichenb.	Watercress	lĕkō;lĕkō-ke'oke'o
EUPHORBIACEAE: Spurge Family <u>Aleurites moluccana</u> (L.) Willd.	Candlenut tree	kukui
GOODENIACEAE: Naupaka Family + <u>Scaevola taccada</u> (Gaertn.) Roxb.	Beach naupaka	naupaka-kahakai
LEGUMINOSAE: Pea Family		
* <u>Acacia koa</u> Gray		koa
<u>Albizia</u> sp.	Albizzia	
* <u>Erythrina sandwicensis</u> Deg.		wiliwili
<u>Leucaena leucocephala</u> (Lam.) deWit	Wild tamarind	koa-haole
<u>Prosopis pallida</u> (Willd.) HBK.	Algaroba; mesquite	kiawe
<u>Samanea saman</u> (Jacq.) Merr.	Monkeypod	'ohai
MALVACEAE: Mallow Family		
+ <u>Hibiscus tiliaceus</u> L.		hau
<u>Sida</u> sp.		'ilima
<u>Thespesia populnea</u> (L.) Correa	Portia-tree	milo
MORACEAE: Mulberry Family		
<u>Artocarpus altilis</u> (Z.) Fosb.	Breadfruit	'ulu
<u>Ficus microcarpa</u> L.f.	Chinese banyan	
MYRTACEAE: Myrtle Family		
<u>Eucalyptus</u> sp.	Eucalyptus	
<u>Eugenia cumini</u> (L.) Druce	Java plum	palama
<u>Eugenia jambos</u> L.	Rose apple	'ōhi'a-loke
* <u>Metrosideros collina</u> subsp.		'ōhia;a-lehua
<u>polymorpha</u> (Gaud.)Rock		
<u>Psidium cattleianum</u> Sabine	Strawberry guava	waiwai-'ula'ula
<u>Psidium guajava</u> L.	Guava	kuawa

PLANTS (continued)

<u>Scientific Name and Family</u>	<u>Common Name(s)</u>	<u>Hawaiian Name(s)</u>
DICOTYLEDONAE: (continued)		
NYMPHAEACEAE: Water Lily Fam. <u>Nelumbo nucifera</u> Gaertn. <u>Nymphaea</u> sp.	Indian lotus; hasu Water lily	lilia-lana-i-ka-wai
ONAGRACEAE: Evening Primrose Family <u>Ludwigia octivalvis</u> (Jacq.) Raven	Primrose willow	kāmole
PROTEACEAE: Protea Family <u>Grevillea robusta</u> A. Cunn.	Silk oak; silver oak	'oka-kilika
RHIZOPHORACEAE: Mangrove Fam. <u>Bruguiera gymnorrhiza</u> (L.)Lam. <u>Rhizophora mangle</u> L.	Oriental mangrove Mangrove; American mangrove	kukuna-o-ka-la
VERBENACEAE: Verbena Family <u>Lantana camara</u> L.	Lantana	lākana; mikinolia-hihiu

KEY: * denotes endemic form
 + denotes indigenous form