

## Section 5

# GEOGRAPHY AND ENVIRONMENT

This section relates to land and water areas, physical geography, climate, air and water quality, and other geographic and environmental measurements of Hawaii. Most statistics on land use and ownership, however, appear in Section 6.

Important sources of data include the U.S. Geological Survey, the National Ocean Survey, the National Climatic Data Center, the Division of Water Resource Management of the Hawaii State Department of Land and Natural Resources, the Hawaii State Department of Health, and the University of Hawaii Institute of Geophysics. Detailed information is given in *Atlas of Hawaii*, 2nd edition, published by the University of Hawaii Press in 1983. National data are reported in the *Statistical Abstract of the United States: 1996*, Section 6.

**Table 5.01-- GREAT CIRCLE DISTANCES BETWEEN SPECIFIED PLACES**

<b>Places</b>	<b>Statute miles</b>	<b>Nautical miles</b>	<b>Kilometers</b>
<b>DISTANCES FROM HONOLULU INTERNATIONAL AIRPORT</b>			
Hawaiian Islands locations:			
Hilo, Hawaii	214	186	344
Kailua, Kona, Hawaii	168	146	270
Kahului, Maui	98	85	158
Lanai Airport	72	63	116
Molokai Airport	54	47	87
Lihue, Kauai	103	90	166
Puuwai, Niihau	152	132	245
Nihoa	283	246	455
Necker Island	520	452	837
French Frigate Shoals	556	483	895
Gardner Pinnacles	688	598	1,107
Maro Reef	851	739	1,369
Laysan Island	936	813	1,506
Lisianski Island	1,065	925	1,714
Pearl and Hermes Atoll	1,208	1,050	1,944
Midway Islands	1,309	1,137	2,106
Kure Atoll	1,367	1,188	2,200
Other Pacific locations:			
Apra Harbor, Guam	3,806	3,307	6,124
Auckland, New Zealand	4,393	3,817	7,068
Baker Island	1,900	1,649	3,058
Hong Kong	5,541	4,815	8,915
Howland Island	1,900	1,649	3,058
Jarvis Island	1,560	1,354	2,511
Johnston Atoll	820	713	1,319
Kingman Reef	1,073	932	1,726
Kiritimati (Christmas Island), Kiribati	1,344	1,168	2,163
Majuro, Marshall Islands	2,271	1,973	3,654
Manila, Philippines	5,293	4,599	8,516
Nuku Hiva, Marquesas Islands	2,400	2,086	3,864
Pago Pago, American Samoa	2,606	2,265	4,193
Palmyra Atoll	1,101	957	1,772
Papeete, Tahiti	2,741	2,382	4,410
Suva, Fiji	3,159	2,745	5,083
Sydney (Port Jackson), Australia	5,070	4,406	8,158
Tokyo, Japan	3,847	3,343	6,190
Wake Island	2,294	1,993	3,691

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**Table 5.01-- GREAT CIRCLE DISTANCES BETWEEN SPECIFIED PLACES -- Con.**

Places	Statute miles	Nautical miles	Kilometers
DISTANCES FROM HONOLULU INT. AIRPORT--Con.			
North and South American locations:			
Anchorage, Alaska	2,781	2,417	4,475
Cape Horn, Chile	7,457	6,480	11,998
Chicago, Illinois	4,179	3,631	6,724
Cristobal, Canal Zone	5,214	4,531	8,389
Los Angeles, California	2,557	2,222	4,114
Miami, Florida	4,856	4,220	7,813
New York, New York	4,959	4,309	7,979
Portland, Oregon	2,595	2,255	4,175
San Diego, California	2,610	2,268	4,199
San Francisco, California	2,397	2,083	3,857
Seattle, Washington	2,679	2,328	4,311
Vancouver, B.C.	2,709	2,354	4,359
Tijuana, Mexico	2,616	2,273	4,209
Washington, D.C.	4,829	4,196	7,770
London, England	7,226	6,279	11,627
Bombay, India	8,010	6,960	12,888
Ghanzi, Botswana 1/	12,417	10,790	19,979
Equator, due south of Honolulu	1,470	1,277	2,367
North Pole	4,740	4,119	7,631
OTHER DISTANCES			
Hilo to --			
Los Angeles, California	2,447	2,126	3,937
San Francisco, California	2,315	2,012	3,725
Kure Atoll to --			
Cape Kumukahi, Puna, Hawaii 2/	1,523	1,323	2,451
Log Point, Elliot Key, Florida 3/	5,852	5,085	9,416
Tokyo, Japan	2,486	2,160	4,000
West Quoddy Head, Maine	5,788	5,030	9,313

1/ Ghanzi, Botswana, is Honolulu's antipode, that is, the point precisely opposite to it on the globe.

2/ Cape Kumukahi and Kure Atoll are the points farthest apart in the Hawaiian Archipelago and State of Hawaii.

3/ Log Point and Kure Atoll are the points farthest apart in the 50 states.

Source: U.S. Department of the Interior, Geological Survey, *Elevations and Distances in the United States* (1980), pp. 22-23, and records; E. H. Bryan, Jr., *American Polynesia and the Hawaiian Chain* (1942), pp. 38, 42, and 134.

**Table 5.02-- LATITUDES AND LONGITUDES OF SELECTED PLACES**

Island and place	Latitude (North)	Longitude (West)
Hawaii:		
Hilo (International Airport)	19°43'	155°04'
Cape Kumukahi	19°31'	154°49'
Ka Lae	18°56'	155°41'
Keahole Point	19°44'	156°04'
Upolu Point	20°16'	155°51'
Geographic center of State (off Maui)	20°15'	156°20'
Maui:		
Wailuku	20°53'	156°30'
Kahului (Airport)	20°54'	156°26'
Hana	20°45'	155°59'
Cape Hanamanioa	20°35'	156°25'
Lahaina	20°52'	156°41'
Kahoolawe:		
Puu Moaulanui	20°34'	156°34'
Lanai:		
Airport	20°48'	156°57'
Molokai:		
Kaunakakai	21°05'	157°02'
Laaupoint	21°06'	157°19'
Cape Halawa	21°10'	156°43'
Oahu:		
Honolulu: International Airport	21°20'	157°55'
Aloha Tower	21°19'	157°52'
Kaena Point	21°35'	158°17'
Kahuku Point	21°43'	157°59'
Makapuu Point	21°19'	157°39'
Diamond Head	21°16'	157°49'
Kauai:		
Lihue (Kauai Airport)	21°59'	159°21'
Mana	22°02'	159°46'
Kilauea Point	22°14'	159°24'
Niihau:		
Puuwai	21°54'	160°12'
Kure Atoll	28°25'	178°22'

Source: U.S. Board on Geographic Names, *Gazetteer No. 24, Hawaiian Islands* (1956); U.S. Geological Survey, *Elevations and Distances in the United States* (1980), pp. 17 and 22-23; U.S. Department of Commerce, National Climatic Data Center, *Local Climatological Data, Annual Summary with Comparative Data, 1984* for Hilo, Kahului, Honolulu, and Lihue; Bernice P. Bishop Museum, records; Hawaii State Department of Accounting and General Services, Survey Division, records.

**Table 5.03-- TIME DIFFERENTIALS BETWEEN HONOLULU AND  
SELECTED CITIES: 1995**

City	June		December	
	Day	Hour	Day	Hour
Honolulu	Same	12:00 N	Same	12:00 N
Los Angeles	Same	3:00 PM	Same	2:00 PM
Denver	Same	4:00 PM	Same	3:00 PM
Houston	Same	5:00 PM	Same	4:00 PM
Chicago	Same	5:00 PM	Same	4:00 PM
Atlanta	Same	6:00 PM	Same	5:00 PM
Washington	Same	6:00 PM	Same	5:00 PM
New York	Same	6:00 PM	Same	5:00 PM
London	Same	11:00 PM	Same	10:00 PM
Singapore	Next	6:00 AM	Next	6:00 AM
Hong Kong	Next	6:00 AM	Next	6:00 AM
Manila	Next	6:00 AM	Next	6:00 AM
Tokyo	Next	7:00 AM	Next	7:00 AM
Sydney	Next	8:00 AM	Next	9:00 AM

Source: GTE Hawaiian Telephone Company, *Oahu Telephone Book April 1995-1996*, p. 38; consulates; airlines.

**Table 5.04-- WIDTHS AND DEPTHS OF CHANNELS**

Channel 1/	Width 2/		Depth 3/	
	Statute miles	Kilometers	Feet	Meters
Alenuihaha (Hawaii-Maui)	29.6	47.6	6,810	2,076
Alalakeiki (Kahoolawe-Maui)	6.7	10.8	822	251
Kealaikahiki (Kahoolawe-Lanai)	17.8	28.6	1,086	331
Auau (Lanai-Maui)	9.5	15.3	252	77
Kalohi (Lanai-Molokai)	9.2	14.8	540	165
Pailolo (Maui-Molokai)	8.8	14.2	846	258
Kaiwi (Molokai-Oahu)	25.8	41.5	2,202	671
Kauai (Oahu-Kauai)	72.1	116.0	10,890	3,319
Kaulakahi (Kauai-Niihau)	17.2	27.7	3,570	1,088
Niihau-Kaula	21.5	34.6	5,364	1,635
Niihau-Nihoa	133.9	215.5	14,550	4,435
Nihoa-Necker I.	179.6	289.0	12,600	3,840
Necker I.-French Frigate Shoals	100.3	161.4	12,780	3,895
French Frigate Shoals-Gardner Pinnacles	137.0	220.5	11,448	3,489
Gardner Pinnacles-Marø Reef	155.5	250.3	12,300	3,749
Marø Reef-Laysan I.	65.9	106.1	8,280	2,524
Laysan I.-Lisianski I.	137.4	221.1	16,830	5,130
Lisianski I.-Pearl and Hermes Atoll	162.6	261.7	17,400	5,304
Pearl and Hermes Atoll-Midway Islands	86.9	139.9	15,840	4,828
Midway Islands-Kure Atoll	57.1	91.9	12,960	3,950

1/ Listed in geographic order, from east to west. The channels between major islands were measured between the following points:

- Alenuihaha: Upolu Pt., Hawaii, to Puhilele Pt., Maui;
- Alalakeiki: Lae o ka Ule, Kahoolawe, to Nukuele Pt., Maui;
- Kealaikahiki: Makaalae, Kahoolawe, to Kamaiki Pt., Lanai;
- Auau: Kikoa Pt., Lanai, to Lahaina, Maui;
- Kalohi: Wahie Pt., Lanai, to Kamalo, Molokai;
- Pailolo: Lipoa Pt., Maui, to Pohakuloa, Molokai;
- Kaiwi: Ilio Pt., Molokai, to Makapuu Pt., Oahu;
- Kauai: Kaena Pt., Oahu, to Kamilo Pt., Kauai;
- Kaulakahi: Mana Pt., Kauai, to Kaunuopou, Niihau.

2/ Width measured in statute miles between designated points on National Ocean Survey and Coast and Geodetic Survey charts. Width in kilometers calculated from miles (1 mile = 1.60934 km.).

3/ Depths given are the deepest soundings noted at or near the line joining the two designated points, on National Ocean Survey and Coast and Geodetic Survey charts. Depths measured in fathoms and converted to feet and meters (1 fathom = 6 feet = 1.8288 meters).

Source: Compiled by Lee S. Motteler, Geography and Map Division, Bernice P. Bishop Museum, in November 1980.

**Table 5.05-- GENERAL COASTLINE AND TIDAL SHORELINE OF COUNTIES AND ISLANDS**

County and island	General coastline 1/		Tidal shoreline 2/	
	Statute miles	Kilometers 3/	Statute miles	Kilometers 3/
State total	750	1,207	1,052	1,693
Counties:				
Hawaii	266	428	313	504
Maui, including Kalawao	210	338	343	552
Honolulu	137	220	234	377
Kauai	137	220	162	261
Islands: 4/				
Hawaii	266	428	313	504
Maui	120	193	149	240
Kahoolawe	29	47	36	58
Lanai	47	76	52	84
Molokai	88	142	106	171
Oahu	112	180	209	336
Kauai	90	145	110	177
Niihau	45	72	50	80
Kaula	2	3	2	3
Northwestern Hawaiian Islands 5/	25	40	25	40
Niihoa	3	5	3	5
Necker Island	2	3	2	3
French Frigate Shoals	6	10	6	10
Laysan Island	6	10	6	10
Lisianski Island	3	5	3	5
Kure Atoll	5	8	5	8

1/ Figures are lengths of general outline of seacoast. Data for the four islands of Maui County are not consistent with the reported county total.

2/ Shoreline of outer coast, offshore islands, bays, rivers, and creeks is included to the head of tidewater or to a point where tidal waters narrow to a width of 100 feet.

3/ Derived from data expressed in statute miles; independently rounded and accordingly may not add exactly to indicated totals and subtotals. 1 mi. = 1.609 km.

4/ Data are not available for five minor islands: Molokini, Lehua, Gardner Pinnacles, Maro Reef, and Pearl and Hermes Atoll.

5/ Excludes the Midway Islands, which are part of the Hawaiian Archipelago but not legally part of the State of Hawaii. Midway has a general coastline of 20 miles and a tidal shoreline of 33 miles.

Source: U.S. Department of Commerce, National Ocean Survey, *The Coastline of the United States* (1975) and records.

**Table 5.06-- LAND AND WATER AREA WITHIN  
THE FISHERY CONSERVATION ZONE**

[Land and water area within the 200 nautical mile Fishery Conservation Zone surrounding the  
Hawaiian Archipelago]

<b>Unit</b>	<b>Total area</b>	<b>Land area</b>	<b>Water area</b>
Square nautical miles	634,023	4,852	629,171
Square statute miles	839,623	6,425	833,198
Square kilometers	2,174,626	16,641	2,147,985

Source: Marine Surveys and Maps, National Ocean Survey, National Oceanic and Atmospheric Administration, information supplied September 15, 1978.

**Table 5.07-- LAND AND WATER AREA OF COUNTIES: 1990**

[See maps on pages 6 and 7]

<b>Measurement unit and type of area</b>	<b>State total</b>	<b>Hawaii</b>	<b>Maui</b>	<b>Kalawao</b>	<b>Honolulu</b>	<b>Kauai</b>
Square miles:						
Land	6,423.4	4,028.2	1,159.3	13.2	600.2	622.5
Inland water 1/	35.9	4.4	3.6	-	19.0	8.9
Territorial water 2/	4,472.4	1,054.3	1,236.0	39.1	1,507.8	635.1
Square kilometers:						
Land	16,636.5	10,433.1	3,002.5	34.2	1,554.5	1,612.2
Inland water 1/	92.9	11.5	9.3	-	49.2	22.9
Territorial water 2/	11,583.4	2,730.7	3,201.2	101.3	3,905.2	1,644.9
Acres:						
Land	4,110,966	2,578,073	741,933	8,451	384,125	398,383
Inland water 1/	22,976	2,816	-	2,304	12,160	5,696
Territorial water 2/	2,862,336	674,752	791,040	25,024	964,992	406,464

1/ Lakes, streams, reservoirs, etc. Includes Pearl Harbor.

2/ Within three miles of coast.

Source: U.S. Bureau of the Census, *1990 Census of Population and Housing, Summary Population and Housing Characteristics, Hawaii*, 1990 CPH-1-13 (August 1991), table 15, and unpublished records.

**Table 5.08-- LAND AREA OF ISLANDS: 1990**

Island	Square miles 1/	Square kilometers	Acres 1/
State total	6,423.4	16,636.5	4,110,966
Hawaii	4,028.2	10,433.1	2,578,073
Maui	727.3	1,883.7	465,472
Molokini	0.036	0.093	23
Kahoolawe	44.6	115.5	28,543
Lanai	140.5	364.0	89,946
Molokai	260.0	673.5	166,425
Oahu	597.1	1,546.5	382,148
Kauai	552.3	1,430.5	353,484
Niihau	69.5	179.9	44,455
Lehua	0.444	1.149	284
Kaula	0.247	0.640	158
Northwestern Hawaiian Islands 2/	3.108	8.049	1,989
Nihoa	0.271	0.701	173
Necker Island	0.071	0.183	45
French Frigate Shoals	0.096	0.249	62
Gardner Pinnacles	0.009	0.024	6
Maro Reef	Awash	Awash	Awash
Laysan Island	1.588	4.114	1,017
Lisianski Island	0.601	1.556	384
Pearl and Hermes Atoll	0.139	0.359	89
Kure Atoll	0.333	0.863	213
OTHER ISLANDS 3/			
Baker, Howland, and Jarvis Islands	2.9	7.5	1,853
Johnston Atoll	1.1	2.8	692
Kingman Reef	0.4	1.0	247
Midway Islands	2.5	6.4	1,581
Palmyra Atoll	4.6	11.9	2,941

1/ Areas in square miles and acres were calculated directly from measurements in .001 square kilometers and independently rounded. 1 square mile = 640 acres = 2.58999 square kilometers.

2/ Exclusive of the Midway Islands, which are part of the Hawaiian Archipelago but not legally part of the State of Hawaii.

3/ In central Pacific, not legally part of the State of Hawaii.

Source: U.S. Bureau of the Census, *1990 Census of Population and Housing, Summary Population and Housing Characteristics, Hawaii*, 1990 CPH-1-13 (August 1991), table 15; *Population and Housing Unit Counts, United States*, 1990 CPH-2-1 (October 1993), table 1; Summary Tape File 1B; and letter from Geography Division, March 30, 1992.

**Table 5.09-- MAJOR AND MINOR ISLANDS IN THE  
HAWAIIAN ARCHIPELAGO**

Classification	Number of islands		Land area (square miles)
	Total	Inhabited, 1990 1/	
All named islands	137	12	6,427.0
Major islands	8	7	6,419.4
Named minor islands 2/	129	5	7.6
Offshore of major islands	96	3	2.6
Northwestern Hawaiian Islands 3/	33	2	4.9
Part of State	28	1	2.9
Not part of State (Midway Islands)	5	1	2.0

1/ For populations, see present volume, table 1.05.

2/ For individual data, see DPED Report GN-6, pp. 3-7.

3/ Includes individual islets in the 10 Northwestern Hawaiian Islands.

Source: Hawaii State Department of Planning and Economic Development, *Geographic Names Approved, Second Quarter 1969* (Report GN-6, July 8, 1969), p. 8; *Data Book 1986*, table 152.

**Table 5.10-- AREA AND DEPTH OF SELECTED CRATERS**

Island and crater	Area (acres)	Maximum depth (feet)
Hawaii:		
Kilauea Caldera	2,319	476
Mokuaweoweo Crater 1/	2,221	572
Maui:		
Haleakala Crater 2/	12,575	3,028
Oahu:		
Diamond Head Crater	255	562
Koko Crater	133	968
Punchbowl Crater	62	140

1/ Data exclude North and South Pits.

2/ Data exclude Koolau and Kaupo Gaps.

Source: Measured from U.S. Geological Survey maps by DBEDT.

**Table 5.11-- ELEVATIONS OF MAJOR SUMMITS**

[Elevation of the highest point on each island and other important peaks]

<b>Island and summit</b>	<b>Feet</b>	<b>Meters</b>
Hawaii:		
Mauna Kea 1/	13,796	4,205
Mauna Loa	13,679	4,169
Hualalai	8,271	2,521
Kaumu o Kaleihoohe	5,480	1,670
Kilauea (Uwekahuna)	4,093	1,248
Kilauea (Halemaumau Rim)	3,660	1,116
Kahoolawe:		
Puu Moaulanui	1,483	452
Puu Moaulaiki	1,434	437
Molokini	160	49
Maui:		
Haleakala (Red Hill)	10,023	3,055
Haleakala (Kaupo Gap)	8,201	2,500
Puu Kukui	5,788	1,764
Iao Needle	2,250	686
Lanai:		
Lanaihale	3,366	1,026
Molokai:		
Kamakou	4,961	1,512
Olokui	4,606	1,404
Kalaupapa Lookout	1,600	488
Mauna Loa (Kukui)	1,430	436
Oahu:		
Kaala	4,003	1,220
Puu Kalena	3,504	1,068
Konahuanui	3,150	960
Tantalus	2,013	614
Olomana	1,643	501
Koko Crater (Kohelepelepe)	1,208	368
Nuuanu Pali Lookout	1,186	361
Diamond Head	760	232
Koko Head	642	196
Punchbowl	500	152

Continued on next page.

**Table 5.11-- ELEVATIONS OF MAJOR SUMMITS -- Con.**

Island and summit	Feet	Meters
Kauai:		
Kawaikini	5,243	1,598
Waialeale	5,148	1,569
Kalalau Lookout	4,120	1,256
Haupu	2,297	700
Sleeping Giant (Nonou)	1,241	378
Niihau:		
Paniau	1,250	381
Lehua	699	213
Kaula	548	167
Nihoa:		
Millers Peak	903	275
Necker Island:		
Summit Hill	276	84
French Frigate Shoals:		
La Perouse Pinnacles	120	37
Gardner Pinnacles	190	58
Maro Reef	Awash	Awash
Laysan Island	40	12
Lisianski Island	40	12
Pearl and Hermes Atoll	10	3
Midway Islands	12	4
Kure Atoll	20	6

1/ According to the *1995 Guinness Book of Records* (p. 147), "The world's tallest mountain measured from its submarine base (3,280 fathoms) in the Hawaiian Trough to its peak is Mauna Kea ... with a combined height of 33,480 ft., of which 13,796 ft. are above sea level."

Source: Hawaii State Department of Accounting and General Services, Survey Division, data provided April 21, 1992; U.S. National Cartographic Information Center, data provided October 11, 1978; U.S. Geological Survey topographic maps, 1981-1984; Hawaiian Government Survey (for Nihoa and Molokini); U.S.S. Tanager survey, 1923 (for Necker Island, French Frigate Shoals, Laysan, Lisianski, Pearl and Hermes Atoll and Kure Atoll.)

**Table 5.12-- MAJOR NAMED WATERFALLS, BY ISLANDS: 1994**

Island	Waterfall	Height (feet)		Horizontal distance (feet)
		Sheer drop	Cascade	
Hawaii	Kaluahine	...	620	400
	Akaka	442	...	...
	Waiilikahi	320	...	6
Maui	Honokohau	...	1,120	500
	Waihiumalu	...	400	150
Molokai	Kahiwa	...	1,750	1,000
	Papalaua	...	1,200	500
	Waialele	...	500	150
Oahu	Kaliuwaa (Sacred)	1/ 80	1,520	3,000
Kauai	Waipoo (2 falls)	...	800	600
	Awini	...	480	500
	Hinalele	280	...	...
	Wailua	200	...	...

1/ Refers to northernmost fall of a cascade of six falls.

Source: U.S. Geological Survey, records; Hawaii State Department of Land and Natural Resources, Division of Water Resource Management, records; "Tall Falls," *The Honolulu Advertiser*, June 25, 1995, pp. A17 and A20.

**Table 5.13-- MAJOR STREAMS, BY ISLANDS: 1994**

<b>Island</b>	<b>Feature or stream</b>	<b>Length or average discharge</b>
Longest water feature (miles):		
Hawaii	Wailuku River	32.0
Maui	Kalialinui-Waiale Gulch	18.0
Kahoolawe	Ahupu Gulch	4.0
Lanai	Maunalei-Waialala Gulch	12.9
Molokai	Wailau-Pulena Stream	6.5
Oahu	Kaukonahua Stream (So. Fork)	33.0
Kauai	Waimea River-Poomau Stream	19.5
Niihau	Keanaulii-Puniopo Valley	5.9
Largest perennial stream (miles): 1/		
Hawaii	Wailuku River	22.7
Maui	Palikea Stream	7.8
Molokai	Wailau-Pulena Stream	6.5
Oahu	Kaukonahua Stream	30.0
Kauai	Waimea River	19.7
Streams with greatest average discharge 2/ (million gal./day):		
Hawaii	Wailuku River	250
Maui	Iao Stream	43
Molokai	Wailau Stream	30
Oahu	Waikele Stream	3/ 27
Kauai	Hanalei River	140

1/ Estimated on basis of drainage area rather than stream runoff. Other major streams include Wailoa River, Hawaii (1/2-mile long); Honokohau Stream (9.4 miles long) and Iao Stream (5), both on Maui; Halawa Stream (6.4), Waikolu Stream (4.7), and Pelekunu (2.3), all on Molokai; Waikele Stream (15.3), Kipapa Stream (12.8), Waiakakalaua Stream (11.8), Nuuanu Stream (4), and Ala Wai Canal (1.9), all on Oahu; and the Makaweli River (15.1), Wainiha River (13.8), Hanapepe River (13.3), and Wailua River (11.8), all on Kauai.

2/ Most recent available year.

3/ Most of discharge is from nearby groundwater outflow.

Source: Longest water feature from U.S. Geological Survey, records; other data from Hawaii State Department of Land and Natural Resources, Division of Water Resource Management, records.

**Table 5.14-- LAKES AND LAKE-LIKE WATERS, BY ISLANDS: 1994**

Island and lake	Type	Elevation (feet)	Area 1/ (acres)	Maximum depth (feet)
Hawaii:				
Green Lake	Lake	3	2	20
Lake Waiau 2/	Lake	13,020	2	10
Waiakea Pond	Tidal pond	(SL)	27	7
Maui:				
Kanaha Pond	Marsh	(SL)	41	3
Kealia Pond	Marsh	(SL)	500	(NA)
Waieleele	Pond	6,690	0.5	21
Molokai:				
Kauhako	Pool	(SL)	0.9	814
Kualapuu Reservoir	Reservoir	821	100	50
Meyer Lake	Impoundment	2,021	6-10	5
Oahu:				
Ho'omaluhia	Reservoir	202	90	90
Kaelepulu Pond	Lake	(SL)	198	(NA)
Kawainui Marsh	Marsh	(SL)	1,000	(NA)
Wahiawa Reservoir	Reservoir	842	302	85
Kauai:				
Nomilu Fishpond	Pond	(SL)	20	66
Waita Reservoir	Reservoir	241	424	23
Niihau:				
Halalii Lake	Playa	(SL)	841-865	(NA)
Halulu Lake	Playa	(SL)	182-371	(NA)
Laysan:				
Laysan Lagoon	Closed lagoon	(SL)	161	16

NA Not available.

SL Sea level.

1/ Ranges shown for Meyer Lake, Halalii Lake, and Halulu Lake reflect differences in estimates between sources.

2/ Highest lake in the State and third highest in the United States.

Source: J.A. Maciolek, *Lakes and Lake-like Waters of the Hawaiian Archipelago* (Bernice P. Bishop Museum, Occasional Papers, Vol. XXV, No. 1, April 30, 1982); *Data Book 1992*, table 143; Hawaii State Department of Land and Natural Resources, Division of Water Resource Management, May 18, 1994.

**Table 5.15-- LENGTH AND WIDTH OF SELECTED BEACHES**

[Includes the longest white sand beach on each inhabited island, plus other important beaches]

Island and beach	Length (miles)	Width 1/ (feet)
Hawaii: Hapuna	0.5+	200+
Maui: Spreckelsville	2+	(NA)
Kaanapali	1.5	60-80
Lanai: Polihua	1.5+	(NA)
Molokai: Papohaku	2+	300
Oahu: Waikiki	2	(NA)
Waimanalo	3.5-4.5	(NA)
Sunset	2-3+	200
Kauai: Polihale to Kekaha	15	300
Polihale	3	300
Niihau: Keawanui	3.5	175

NA Not available.

1/ Summer averages. Many beaches in Hawaii are seasonally reduced in width by winter storms.

Source: Hawaii State Department of Planning and Economic Development, *Hawaii's Shoreline* (1965), pp. 33, 47, 55, 62, 68, and 100; John R. K. Clark, *Beaches of the Big Island* (1985), p. 132, *The Beaches of Maui County* (1980), pp. 10, 62, 84-85, and 114, *The Beaches of O'ahu* (1977), pp. 45, 125, and 177, and *Beaches of Kaua'i and Ni'ihau* (1990), pp. 48-49 and 84.

**Table 5.16-- MISCELLANEOUS GEOGRAPHIC STATISTICS, BY ISLAND**

<b>Island</b>	<b>Extreme length (miles)</b>	<b>Extreme width (miles)</b>	<b>Miles of sea cliffs with heights 1,000 ft. or more 1/</b>	<b>Miles from coast of most remote point</b>	<b>Percent of area within 5 miles of coast</b>
The State	...	...	33	28.5	48.6
Hawaii	93	76	4	28.5	30.0
Maui	48	26	-	10.6	76.1
Kahoolawe	11	6	-	2.4	100.0
Lanai	18	13	1	5.2	100.0
Molokai	38	10	14	3.9	100.0
Oahu	44	30	-	10.6	79.0
Kauai	33	25	11	10.8	65.0
Niihau	8	6	3	2.4	100.0
	<b>Percent of area with elevation --</b>			<b>Percent of area with slope --</b>	
	<b>Less than 500 feet</b>	<b>2,000 feet or more</b>	<b>Approximate mean altitude (feet)</b>	<b>Less than 10 percent</b>	<b>20 percent or more</b>
The State	20.8	50.9	3,030	63.5	17.0
Hawaii	12.0	68.4	3,950	76.0	4.0
Maui	24.9	41.4	2,390	38.5	36.0
Kahoolawe	38.9	0.0	600	60.0	9.0
Lanai	24.8	6.3	1,140	61.0	16.0
Molokai	37.3	17.8	1,150	53.0	26.0
Oahu	45.3	4.6	860	42.5	45.5
Kauai	35.6	24.0	1,380	33.5	50.5
Niihau	78.2	0.0	530	68.0	12.5

1/ According to Lee S. Motteler, Geography and Map Division, Bernice P. Bishop Museum, the sea cliffs along the northeastern coast of Molokai between Umilehi Point and Puukaoku Point drop 3,250 feet at an average slope of 58 degrees. These cliffs have been described by *The Guinness Book of Records* (1995 edition, p. 154) as "the highest sea cliffs in the world."

Source: Hawaii State Department of Planning and Economic Development, *Hawai'i the Natural Environment* (1974), p. 19; U.S. Geological Survey, *Elevations and Distances in the United States* (1978), pp. 4-5.

**Table 5.17-- VOLCANIC ERUPTIONS: 1969 TO 1995**

[Complete through December 31, 1995. Four volcanoes have erupted in historical times: Haleakala, last active around 1790; Hualalai, last active in 1800-1801; and Kilauea and Mauna Loa, both active in recent years and included in this table]

Volcano and date of outbreak	Repose period since previous eruption (months)	Duration (days)	Location 1/	Elevation (meters)	Area (square km.)	Volume (mil. cubic meters)
Mauna Loa:						
1975: July 5	301	<1	S	3,900	13.5	30.0
1984: March 25	104	22	S, ER	4,030-2,870	28.5	176.0
Kilauea:						
1969: Feb. 22	4.0	6	ER	930-870	6.0	16.1
May 24	2.0	867	ER	940	12.5	176.7
1971: Aug. 14	-	<1	C	1,100-1,080	3.1	9.1
Sept. 24	-	5	C, SWR	1,120-820	3.9	7.7
1972: Feb. 4	4.3	455	ER	940	35.1	119.6
1973: May 5	-	<1	ER	1,000-980	0.3	1.2
Nov. 10	-	30	ER	980-870	1.0	2.7
Dec. 12	0.1	203	ER	940	8.1	28.7
1974: July 19	-	3	C, ER	1,080-980	3.1	6.6
Sept. 19	2.0	<1	C	1,100	1.0	10.2
Dec. 31	3.4	<1	SWR	1,080	7.5	14.3
1975: Nov. 29	11.0	<1	C	1,080-1,060	0.3	0.2
1977: Sept. 13	21.5	18	ER	620-480	7.8	32.9
1979: Nov. 16	26.3	1	ER	980-960	0.3	0.6
1982: April 30	29.5	<1	C	1,080	0.3	0.5
Sept. 25	4.8	<1	C	1,080	<1.0	3.0
1983: Jan. 3 2/	3.3	4,745	ER	780-650	94.6	1,300

1/ C, caldera; ER, east rift; S, summit; SWR, southwest rift.

2/ Still in progress, December 31, 1995. As of that time, there had been 53 separate episodes. These had destroyed 181 housing units and added 540 acres to the area of the island.

Source: Gordon A. Macdonald, Agatin T. Abbott, and Frank L. Peterson, *Volcanoes in the Sea*, 2nd ed. (1983), pp. 64-65 and 80-81; U.S. Geological Survey, Hawaiian Volcano Observatory, records.

**Table 5.18-- EARTHQUAKES OF MAGNITUDE 5 OR GREATER:  
1975 TO 1995**

[Complete to July 23, 1995]

<b>Date and time (HST)</b>	<b>Location</b>	<b>Magnitude (Richter scale)</b>
1975: Jan. 2, 3:27 AM	Near Pahala, Hawaii	5.0
Nov. 29, 3:35 AM	Puna, Hawaii	5.7
Nov. 29, 4:47 AM	Puna, Hawaii	7.2
1976: Feb. 20, 7:51 PM	Between Maui and Hawaii	5.1
1977: Jan. 22, 12:36 PM	100 miles S. of Kauai	5.1
Apr. 20, 6:49 PM	Hamakua, Hawaii	5.0
June 5, 11:42 PM	Puna, Hawaii	5.1
1979: Mar. 29, 11:06 PM	40 miles S.W. of Oahu	5.5
Sept. 21, 9:59 PM	Puna, Hawaii	5.5
1981: Mar. 5, 4:09 AM	Molokai area	5.3
Nov. 10, 3:02 AM	Kilauea, Hawaii	5.3
1982: Jan. 21, 11:52 AM	Mauna Loa, Hawaii	5.5
Jan. 21, 12:29 PM	Mauna Loa, Hawaii	5.5
May 14, 6:26 AM	Off Kawaihae, Hawaii	5.0
1983: Mar. 20, 5:18 PM	Off Kalapana, Hawaii	5.0
Sept. 9, 6:30 AM	Off Kalapana, Hawaii	5.4
Nov. 16, 6:13 AM	S.E. flank of Mauna Loa	6.7
1984: June 8, 5:34 PM	80 miles S. of Honolulu	5.3
1986: Apr. 26, 7:19 AM	28 miles N.E. of Maui	5.1
1987: Feb. 3, 4:22 PM	26 miles S. of Kahoolawe	5.0
1988: March 24, 2:30 PM	30 miles S. of Kahoolawe	5.0
March 27, 5:33 PM	30 miles S. of Kahoolawe	5.5
June 7, 12:49 AM	S. flank of Kilauea	5.0
July 3, 7:38 PM	Near Pahala	5.3
July 22, 10:29 AM	Near French Frigate Shoals	5.0
1989: June 25, 5:27 PM	Kalapana area	6.1
Dec. 27, 11:13 PM	Kilauea East Rift Zone	5.1
1990: Aug. 8, 4:06 PM	Kilauea East Rift Zone	5.4
1991: May 7, 10:21 PM	13 miles W. of Kailua-Kona	5.3
1994: Feb. 1, 12:01 AM	Offshore, 12 miles S. of Kilauea	5.2

Source: Hawaii Institute of Geophysics, records; Hawaiian Volcano Observatory Summaries; U.S. Geological Survey, National Earthquake Information Service. Data provided by Paul Okubo, Hawaiian Volcano Observatory, July 24, 1995.

**Table 5.19-- EARTHQUAKES WITH HONOLULU INTENSITIES OF  
V OR GREATER: 1859 TO 1995**

[Complete to July 23, 1995]

Date	Epicentral location	Magnitude (Richter scale)	Honolulu average intensity (Modified Mercalli Scale 1/)
1861: Dec. 5	Molokai-Lanai vic. (?)	(NA)	Mid V
Dec. 15	Molokai-Lanai vic. (?)	(NA)	Lower V - mid V
1868: Apr. 2	SE coast of Hawaii	7.5	Upper IV - lower V
Apr. 4	Maui group vicinity (?)	(NA)	Lower V
1871: Feb. 19	S coast of Lanai	7.0	Upper VI - lower VII
1895: Dec. 8	Oahu vicinity (?)	(NA)	Mid V
1926: Mar. 19	N of Kohala, Hawaii	(NA)	Upper IV - lower V
1929: Oct. 5	W of Kona, Hawaii	6.5	Lower V
1938: Jan. 22	N of Maui	6.8	Upper V - lower VI
1948: June 28	S coast of Oahu	4.8	Mid VI
1964: Oct. 11	Ka Lae, Hawaii	5.5	Upper IV - lower V
1973: Apr. 26	Hamakua coast, Hawaii	6.2	Mid V
1981: Mar. 5	Kalohi Channel	5.0	Mid V

NA Not available.

1/ Modified Mercalli Scale of 1931, 1956 abridged version further simplified. This scale, which extends from I to XII, reads in part:

IV. Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt. Standing autos rock. Windows, dishes, doors rattle. Crockery clashes. In the upper part of range wooden construction creaks.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids distributed, some spilled. Small unstable objects displaced or upset. Doors, shutters, pictures swing. Pendulum clocks stop.

VI. Felt by all. Many frightened, run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books thrown off shelves, pictures off walls. Furniture moved, overturned. Weak plaster and masonry cracked. Small bells ring. Trees, bushes noticeably shaken.

VII. Difficulty in standing. Noticed by drivers of autos. Hanging objects quiver. Furniture broken. Damage to weak masonry. Weak chimneys broken at roof line. Fall of plaster, loose bricks, etc. Some cracks in ordinary masonry. Waves on ponds. Small slides on sand and gravel banks. Large bells ring. Irrigation ditches damaged.

Source: Doak C. Cox, "Earthquake Experience in Honolulu," *The Hawaiian Journal of History*, Vol. 21 (1987), pp. 98-109, as updated by Paul Okubo, Hawaiian Volcano Observatory, July 24, 1995.

**Table 5.20-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE:  
1946 TO 1995**

[Complete to July 23, 1995]

Date	Maximum height in Hawaii		Deaths in Hawaii	Damage in Hawaii (dollars)
	Meters	Feet		
1946: April 1	17.0	55.8	159	26,000,000
1952: Nov. 4	6.1	20.0	-	1,000,000
1957: March 9	16.0	52.5	-	5,000,000
1960: May 22	10.5	34.5	61	23,000,000
1964: March 27	4.8	15.7	-	67,590
1975: Nov. 29	14.6	48.0	2	1,500,000

Source: George Pararas-Carayannis, *Catalog of Tsunamis in the Hawaiian Islands* (U.S. Coast and Geodetic Survey, May 1969); Harold G. Loomis, *The Tsunami of November 29, 1975 in Hawaii* (Hawaii Institute of Geophysics, December 1975), pp. 1 and 10; D.C. Cox and J. Morgan, *Local Tsunamis and Possible Local Tsunamis in Hawaii* (Hawaii Institute of Geophysics, Report HIG 77-14, November 1977); Doak C. Cox, *Tsunami Casualties and Mortality in Hawaii* (University of Hawaii, Environment Center, June 1987), p. 39; Hawaiian Volcano Observatory, information provided July 24, 1995.

**Table 5.21-- MAJOR DAMS: 1994**

<b>Name</b>	<b>Location</b>	<b>Height (ft.)</b>	<b>Length (ft.)</b>	<b>Volume of water impounded (acre-ft.)</b>
Wahiawa Dam	Wahiawa, Oahu	98	460	7,761
Waita	Koloa, Kauai	28	3,250	6,500
Kualapuu	Kualapuu, Molokai	58	7,100	4,265
Alexander Dam	Kalaheo, Kauai	119	600	2,500
Ho'omaluhia Dam	Luluku, Oahu	132	2,200	2,500
Nuuanu No. 4	Honolulu, Oahu	73	1,730	1,420
Waimanalo Dam	Waimanalo, Oahu	62	2,118	182

Source: Hawaii State Department of Land and Natural Resources, Division of Water Resource Management, records.

**Table 5.22-- FRESH WATER USE, BY TYPE, BY ISLANDS: 1990**

[Million gallons per day]

Use	State total	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Niihau
Total	1,443.74	192.69	516.59	2.90	10.97	350.56	369.97	0.06
Ground water	556.71	92.21	99.04	2.90	3.74	313.29	45.47	0.06
Domestic	134.45	18.36	19.32	0.84	0.79	86.02	9.09	0.03
Agricultural	195.42	9.31	41.80	1.96	2.36	120.67	19.29	0.03
Industrial	29.18	3.95	1.85	-	-	22.90	0.48	-
Thermoelectric	95.72	57.13	26.96	-	-	0.65	10.98	-
Commercial	101.94	3.46	9.11	0.10	0.59	83.05	5.63	-
Surface water	887.03	100.48	417.55	-	7.23	37.27	324.50	-
Domestic	1.70	0.51	0.80	-	0.12	-	0.27	-
Agricultural	598.17	13.52	316.10	-	7.11	37.27	224.17	-
Industrial	22.84	16.50	-	-	-	-	6.34	-
Thermoelectric	0.05	-	0.05	-	-	-	-	-
Commercial	0.60	-	0.60	-	-	-	-	-
Hydroelectric	263.67	69.95	100.00	-	-	-	93.72	-

Source: Data compiled by the U.S. Geological Survey and provided by the Hawaii State Department of Land and Natural Resources, Division of Water Resource Management, May 18, 1994.

**Table 5.23-- WATER SERVICES AND CONSUMPTION, FOR COUNTY  
WATERWORKS: 1994 TO 1996**

Geographic area	Number of services, June 30			Consumption (million gallons) 1/		
	1994	1995	1996	1994	1995	1996
State total	222,569	226,998	229,989	73,732	74,990	75,389
City and County of Honolulu	147,368	150,247	152,184	50,407	51,004	51,343
Honolulu 2/	60,850	61,025	61,091	25,653	25,469	25,376
Rest of Oahu	86,518	89,222	91,093	24,754	25,535	25,967
Hawaii County	32,381	32,828	33,094	7,999	8,378	8,363
Kauai County	15,799	16,463	16,793	4,149	4,114	4,206
Maui County	27,021	27,460	27,918	11,177	11,494	11,477
Maui	25,531	25,960	26,409	10,822	11,150	11,138
Molokai	1,490	1,500	1,509	355	344	339

1/ Year ended June 30. The 1995 Oahu data have been revised.

2/ Maunaloa to Moanalua.

Source: Data compiled by Hawaii State Department of Business, Economic Development & Tourism from Honolulu Board of Water Supply, Hawaii County Department of Water Supply, Kauai Department of Water, and Maui Department of Water Supply.

**Table 5.24-- STATE RANKING IN ECONOMIC AND ENVIRONMENTAL  
HEALTH INDICATORS: 1994**

Type of indicators	Number of indicators	Final scores		Hawaii rank 1/
		Median state	Hawaii	
Economic health	20	506	252	1
Environmental health	20	525	360	4

1/ Among the 50 States.

Source: Institute for Southern Studies, "Gold and Green," *Southern Exposure*, Fall 1994, cited in release dated October 12, 1994.

**Table 5.25-- HAZARDOUS WASTE SITES ON THE NATIONAL PRIORITY LIST:  
1991 TO 1995**

[Includes both proposed and final sites]

<b>Subject</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>
Number of sites	2	2	3	4	1/ 4
Rank (among the 50 states)	47	47	47	46	45

1/ The national 50-State total was 1,270 sites in 1995.

Source: EPA data cited in *Statistical Abstract of the United States* for 1992 (p. 215), 1993 (p. 228), 1994 (p. 235), 1995 (p. 237), and 1996 (p. 238).

**Table 5.26-- POLLUTION ABATEMENT CAPITAL EXPENDITURES AND  
OPERATING COSTS: 1990 TO 1994**

[Millions of dollars. Statistics cover manufacturing establishments with 20 employees or more]

Subject and year	Total, including nonmedia	Media				Nonmedia and other
		Total	Air	Water	Solid/ contained waste	
Capital expenditures:						
1990	(NA)	23.2	12.6	(D)	(D)	(NA)
1991	(NA)	4.0	1.8	(D)	(D)	(NA)
1992	2.8	2.8	.5	2.3	-	(Z)
1993	37.3	37.2	1.8	35.3	-	.2
1994	5.7	4.7	2.6	2.1	(Z)	1.1
Operating costs:						
1990	(NA)	12.0	3.5	(D)	(D)	(NA)
1991	(NA)	15.8	(D)	9.0	(D)	(NA)
1992	16.2	12.8	3.3	4.6	4.9	3.4
1993	15.2	12.3	(D)	4.4	(D)	2.8
1994	21.7	20.3	7.4	8.9	4.1	1.4

D Withheld to avoid disclosing data for individual companies.

Z Less than half the unit shown.

NA Not available.

Source: U.S. Bureau of the Census, *Current Industrial Reports, Pollution Abatement Costs and Expenditures, 1994*, MA200(94)-1, May 1996, table 2.

**Table 5.27-- WATER QUALITY AT PUBLIC BEACHES, BY ISLANDS:  
1994 AND 1995**

Island	Number of locations	Number of samples	Enterococci density 1/			
			Lowest 2/	Highest 3/	Number over 7	Mean 4/
1994						
State total	165	2,575	1.0	298.9	30	3.9
Hawaii	43	390	1.0	168.2	8	3.4
Hilo Shoreline	20	197	1.4	168.2	7	5.2
Kona Shoreline	23	193	1.0	7.6	1	2.2
Maui	37	432	1.0	19.2	1	1.8
Lanai	2	4	1.4	16.7	1	4.9
Molokai	2	4	5.5	11.7	1	8.0
Oahu	53	1,437	1.0	298.9	12	5.1
Kauai	28	308	1.1	151.8	7	4.4
1995						
State total	170	2,460	1.0	351.7	38	3.8
Hawaii	37	313	1.0	90.0	6	3.0
Hilo Shoreline	18	212	1.1	90.0	3	3.3
Kona Shoreline	19	101	1.0	80.0	3	2.5
Maui	48	516	1.0	27.0	3	1.9
Lanai	2	4	1.0	9.5	1	3.1
Molokai	2	4	2.6	32.0	1	9.2
Oahu	53	1,282	1.0	351.7	13	5.0
Kauai	28	341	1.2	177.4	8	5.1

1/ Geometric mean, number per 100 ml. The geometric mean standard for Enterococci density is 7 per 100 ml.

2/ The lowest average value in 1994 was that reported at Kaneohe Bay-North (Oahu), Hukilau Hotel Shoreline and Wailuku Breakwater (Maui), and Mauna Kea Beach Hotel-Outfall and Mauna Kea Hotel Beach (Hawaii). In 1995, the lowest average value was that reported for a number of beaches on four islands.

3/ The highest average value in both 1994 and 1995 was that reported for the Ala Wai Canal at the McCully Street Bridge on Oahu.

4/ Not weighted by number of samples.

Source: Hawaii State Department of Health, Clean Water Branch, records.

**Table 5.28-- WATER QUALITY AT SELECTED PUBLIC BEACHES:  
1994 AND 1995**

Island and beach	Number of samples		Enterococci density 1/	
	1994	1995	1994	1995
Hawaii:				
Hapuna Beach	7	9	1.1	1.4
Kahaluu Beach	13	5	2.9	3.4
Kealakekua Bay (curio stand)	3	5	2.2	1.1
Hilo Bay (Mooheau Park)	-	-	...	...
Spencer Beach Park	6	5	2.0	5.1
Maui:				
Kapalua (Fleming) Beach (north)	12	12	2.1	1.1
Kihei (north)	12	12	1.1	2.1
Makena Beach	12	12	1.5	1.8
Seven Pools	11	9	1.1	1.0
Sheraton Kaanapali (shoreline)	12	12	1.3	1.0
Lanai:				
Hulopoe Bay	2	2	1.4	1.0
Molokai:				
Kaunakakai Harbor	2	2	5.5	2.6
Oahu:				
Ala Moana Park (center)	21	12	2.1	4.0
Ewa Beach Park	38	20	2.3	1.6
Haleiwa Beach	23	22	4.6	4.0
Hanauma Bay	41	39	3.8	3.5
Kailua Beach Park	40	22	5.2	6.7
Kuhio Beach	40	42	12.2	8.5
Makaha Beach	38	26	1.7	1.5
Waimea Beach	36	39	6.9	3.9
Kauai:				
Anini Park Pavilion	12	12	2.3	3.3
Kalapaki Beach (middle)	12	12	13.0	13.8
Kekaha (Oomano Pt.)	9	12	1.3	2.3
Poipu Beach Pavilion	9	12	1.1	1.8
West of Lydgate Park (wading pool)	12	14	5.1	5.1

1/ See previous table, footnote 1.

Source: Hawaii State Department of Health, Clean Water Branch, records.

**Table 5.29-- REFUSE AND SEWAGE STATISTICS FOR OAHU:  
1984 TO 1994**

[Fiscal years]

Year	Tons of municipal solid waste delivered 1/			Sewage treated 2/ (millions of gallons)
	Total	City and County refuse vehicles	Other vehicles	
1984	611,386	297,215	314,171	38,283
1985	615,574	272,905	342,669	37,817
1986	681,874	375,847	306,027	37,608
1987	678,392	380,810	297,582	38,199
1988	739,820	403,528	336,292	39,757
1989	778,673	302,851	474,822	39,918
1990	825,058	276,178	548,880	41,763
1991	1,015,842	293,857	721,985	44,484
1992	1,049,647	331,269	718,378	42,705
1993	1,023,113	322,901	700,212	42,415
1994	1,017,367	331,602	685,765	42,756

  

Year	Sewage pumped 2/ (millions of gallons)	Miles of sewers 2/	City and County pump stations	City and County treatment plants
1984	48,320	1,691	51	18
1985	49,361	1,711	51	17
1986	48,559	1,736	55	17
1987	49,542	1,752	57	17
1988	51,713	1,769	59	17
1989	51,623	1,805	59	14
1990	50,858	1,828	62	13
1991	52,849	1,859	64	13
1992	53,290	1,890	65	12
1993	52,480	1,914	67	11
1994	53,298	1,945	69	8

1/ Excludes small landfill controlled by armed forces.

2/ Data limited to system maintained by the City and County of Honolulu, Department of Wastewater Management.

Source: City and County of Honolulu, Department of Public Works, Refuse Collection and Disposal Division, and Department of Wastewater Management, records.

**Table 5.30-- LITTER ALONG OAHU HIGHWAYS: 1979 TO 1993**

<b>Measure</b>	<b>1979</b>	<b>1981</b>	<b>1985</b>	<b>1988</b>	<b>1993</b>
Visible litter items per mile	1,381	1,672	1,038	892	521
Visible beer/soft drink containers per mile	144	80	49	26	28
Indiscriminate dumps per 1,000 miles of driving	8.2	15.7	19.6	14.1	12.6
Abandoned vehicles per 1,000 miles of driving	4.9	23.6	57.4	6.8	2.1

Source: Daniel B. Syrek, *Hawaii Litter: 1993* (Sacramento: The Institute for Applied Research, for the Hawaii State Department of Health, Litter Control Office, August 1993).

**Table 5.31-- AIR QUALITY IN DOWNTOWN HONOLULU: 1985 TO 1995**

[Annual arithmetic means, in micrograms per cubic meter, for total suspended particulates and sulfur oxides. Sampling is conducted about 46 feet above ground on the roof of the State Health Department building, 1250 Punchbowl Street, Honolulu, Hawaii]

Year	Particulates	Sulfur oxides	Year	Particulates	Sulfur oxides
1985	24	<5	1992	28	<5
1986	25	<5	1993	21	<5
1987	26	<5	1994	21	<5
1988	26	<5	1995	20	<5
1989	30	<5			
1990	30	<5	Standards 1/	-	80
1991	30	<5			

1/ Federal standards for total suspended particulates have been dropped and PM<sub>10</sub> standards have been adopted.

Source: Hawaii State Department of Health, Clean Air Branch, data supplied July 1996.

**Table 5.32-- AIR QUALITY AT SPECIFIED LOCATIONS: 1995**

[24-hour sampling, in micrograms per cubic meter]

Sampling station	PM <sub>10</sub> 1/			Sulfur dioxide		
	Annual range		Arithmetic average	Annual range		Arithmetic average
	Minimum	Maximum		Minimum	Maximum	
Oahu:						
Downtown Honolulu	2	37	14	0	22	3
Liliha	5	45	16	...	...	...
Pearl City	0	56	14	...	...	...
Kapolei	10	78	24	0	21	2
Makaiwa	...	...	...	0	15	3
West Beach	1	46	16	0	16	2
Waimanalo	8	29	16	...	...	...
Kauai:						
Lihue	8	37	17	...	...	...

1/ Particulates data for all locations except Downtown Honolulu and Liliha from PM<sub>10</sub> samplers (measuring inhalable particulates of less than 10 micrograms).

Source: Hawaii State Department of Health, Clean Air Branch, data supplied July 1996.

**Table 5.33-- ATMOSPHERIC CARBON DIOXIDE MEASUREMENTS AT  
MAUNA LOA: ANNUAL MEAN VALUES, 1958 TO 1994**

[Parts per million]

Year	Annual average	Year	Annual average	Year	Annual average
1958	1/ 315.17	1971	326.17	1984	344.48
1959	315.83	1972	327.26	1985	345.85
1960	316.75	1973	329.45	1986	347.21
1961	317.49	1974	1/ 329.72	1987	348.98
1962	318.30	1975	3/ 331.14	1988	351.34
1963	318.83	1976	332.04	1989	352.89
1964	2/ 319.04	1977	333.79	1990	354.26
1965	319.87	1978	335.35	1991	355.45
1966	321.21	1979	336.73	1992	356.20
1967	322.02	1980	338.72	1993	356.90
1968	322.83	1981	340.12	1994	358.70
1969	323.93	1982	341.21		
1970	325.27	1983	342.87		

1/ Based on data for 8 months.

2/ Based on data for 9 months.

3/ Based on data for 11 months.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Geophysical Monitoring for Climatic Change, records; provided by Saul Price, National Weather Service, Pacific Region, Honolulu (for 1958-1991) and Mauna Loa Observatory (for 1992-1994).

**Table 5.34-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES**

Island and station	Ground elevation (feet)	Average temperature 1/ (°F.)		Extreme temperature of record (°F.)		Average annual precipitation (inches)
		Coollest month	Warmest month	Lowest	Highest	
Hawaii:						
Hilo Airport	30	71.2	75.9	53	94	128
Hawaii Volcanoes Nat. Park Hdq.	3,970	57.6	63.2	31	93	101
Naalehu	800	70.2	75.1	50	93	47
Kailua	30	72.1	77.3	54	93	25
Puako 2/	5	73.1	79.8	52	98	10
Waimea (Kamuela)	2,670	61.3	66.8	34	90	31
Honokaa	1,070	67.6	75.5	(NA)	(NA)	86
Mauna Kea summit 3/	13,796	31.3	42.5	11	66	20
Maui:						
Hana Airport	60	71.4	77.3	50	94	83
Haleakala summit	10,025	42.6	50.0	14	73	44
Kihei 4/	85	70.9	78.4	49	98	13
Kahului Airport	40	71.5	79.2	48	96	20
Lahaina	45	71.5	78.0	52	97	15
Molokai:						
Kaunakakai	10	(NA)	(NA)	(NA)	(NA)	14
Molokai Airport	450	70.2	77.6	48	91	27
Lanai:						
Lanai City	1,620	65.8	72.8	46	88	37

Continued on next page.

**Table 5.34-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES -- Con.**

Island and station	Ground elevation (feet)	Average temperature 1/ (°F.)		Extreme temperature of record (°F.)		Average annual precipitation (inches)
		Coolest month	Warmest month	Lowest	Highest	
Oahu:						
Honolulu International Airport	10	72.6	81.0	53	94	23
Waikiki (Honolulu Zoo)	10	72.8	80.3	51	95	25
Manoa (Lyon Arboretum)	500	69.9	76.1	49	96	158
Kaneohe (State Hospital)	200	71.0	77.5	43	93	71
Kahuku	25	71.6	78.8	49	95	40
Wheeler AFB	845	68.2	75.5	52	89	40
Waianae	10	72.1	79.7	45	96	20
Kauai:						
Kilauea (town)	315	68.7	75.6	49	94	68
Lihue Airport	100	71.3	79.1	50	90	44
Poipu (Makahuena Pt.)	50	72.1	79.4	50	95	35
Kekaha	9	71.0	78.5	48	95	21
Kokee (Kanalohuluhulu)	3,600	54.7	63.8	29	86	70
Northwestern Hawaiian Islands:						
Midway	10	65.0	78.6	52	89	44

NA Not available.

1/ For some stations, data represent 30-year normals.

2/ Temperature data are for Mahukona.

3/ Based on incomplete and non-continuous data for 1966-1972. Precipitation estimated.

4/ Temperature data refer to Puunene Airport.

Source: Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, data supplied February 14, 1995.

**Table 5.35-- CLIMATIC NORMALS, MEANS, AND EXTREMES FOR HILO,  
KAHULUI, HONOLULU, AND LIHUE AIRPORTS**

Subject	Hilo	Kahului	Honolulu	Lihue
Normal temperatures (°F):				
Daily maximum	81.5	83.9	84.4	81.2
Daily minimum	66.4	67.2	70.0	70.0
Monthly: Coolest month	71.7	71.7	72.9	71.6
Warmest month	76.3	79.3	81.4	79.5
Annual	74.0	75.6	77.2	75.6
Extreme temperatures (°F):				
Record highest	94	97	95	90
Record lowest	53	48	53	50
Normal degree days, base 65°F:				
Heating	-	-	-	-
Cooling	3,284	3,883	4,474	3,883
Precipitation (inches):				
Normal	129.19	20.92	22.02	43.00
Maximum monthly	50.82	14.46	20.79	22.91
Minimum monthly	0.28	0.00	T	T
Maximum in 24 hours	22.30	7.01	17.07	11.54
Relative humidity (percent):				
8 A.M.	80	75	72	78
2 P.M.	68	58	55	67
Wind speed (m.p.h.):				
Mean	7.2	12.8	11.3	12.4
Peak gust	55	54	51	115
Percent of possible sunshine	40	67	70	57
Mean number of days:				
Clear	35.5	130.6	90.4	56.1
Partly cloudy	131.5	145.1	180.2	183.5
Cloudy	198.2	89.5	94.6	125.6
Precipitation .01 inch or more	278.1	100.2	97.6	200.4
Thunderstorms	9.8	4.1	6.6	7.7
Temperature maximum 90° and above	0.8	26.3	36.7	0.2

T Trace amount.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary with Comparative Data, 1995* for Hilo, Kahului, Honolulu, and Lihue.

**Table 5.36-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT**

Month	Normal temperature (°F)			Extreme temperature (°F)		Precipitation (inches)			
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum monthly	Minimum monthly	Maximum in 24 hours
January	80.1	65.6	72.9	87	53	3.55	14.74	0.18	6.72
February	80.5	65.4	73.0	88	53	2.21	13.68	0.06	6.88
March	81.6	67.2	74.4	88	55	2.20	20.79	0.01	17.07
April	82.8	68.7	75.8	89	57	1.54	8.92	0.01	4.21
May	84.7	70.3	77.5	93	60	1.13	7.23	0.05	3.44
June	86.5	72.2	79.4	92	65	0.50	2.46	T	2.28
July	87.5	73.5	80.5	94	66	0.59	2.33	0.03	2.20
August	88.7	74.2	81.4	93	67	0.44	3.08	T	2.35
September	88.5	73.5	81.0	95	66	0.78	2.74	0.05	1.40
October	86.9	72.3	79.6	94	61	2.28	11.15	0.11	7.57
November	84.1	70.3	77.2	93	57	3.00	14.72	0.03	9.15
December	81.2	67.0	74.1	89	54	3.80	17.29	0.06	8.25
Annual	84.4	70.0	77.2	95	53	22.02	20.79	T	17.07

Continued on next page.

**Table 5.36-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT -- Con.**

Month	Relative humidity (percent)		Wind (miles/hour)		Percent of possible sunshine	Mean sky cover, sunrise to sunset 2/	Mean number of days		
	8 A.M.	2 P.M.	Mean speed	Fastest obs. 1/			Clear	Cloudy	Precip. .01 inch or more
January	81	61	9.5	32	65	5.4	9.5	8.5	9.4
February	79	59	10.1	35	67	5.5	8.1	7.8	9.2
March	73	57	11.3	30	71	5.8	7.5	9.4	8.8
April	70	55	11.8	31	70	6.1	5.7	9.8	8.9
May	67	53	11.8	30	71	5.9	6.6	9.0	7.2
June	66	52	12.6	26	73	5.5	6.4	6.3	5.7
July	67	51	13.1	28	76	5.3	7.5	5.3	7.3
August	68	52	12.9	28	77	5.2	8.1	5.9	6.2
September	69	52	11.2	38	77	5.2	8.1	5.9	7.0
October	70	55	10.5	25	70	5.6	7.5	8.4	8.7
November	75	58	10.7	46	63	5.7	7.2	9.1	9.0
December	79	60	10.4	33	62	5.5	8.2	9.0	10.2
Annual	72	55	11.3	46	70	5.6	90.4	94.6	97.6

T Trace amount.

1/ Fastest observation, 2 minutes, during period of record.

2/ Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data, Honolulu, 1995.*

**Table 5.37-- AVERAGE TEMPERATURE, PERCENT OF POSSIBLE SUNSHINE, AND PRECIPITATION, FOR HONOLULU INTERNATIONAL AIRPORT: ANNUALLY, 1950 TO 1995**

Year	Average temperature (deg. F.)	Percent of possible sunshine	Precipitation (inches)	Year	Average temperature (deg. F.)	Percent of possible sunshine	Precipitation (inches)
1950	75.7	(NA)	31.68	1973	77.2	63	14.24
1951	76.3	(NA)	39.73	1974	77.5	61	24.02
1952	75.4	(NA)	10.65	1975	76.2	62	24.39
1953	75.9	71	9.97	1976	76.8	60	12.90
1954	75.8	68	27.30	1977	78.2	68	12.36
1955	74.5	62	37.86	1978	76.8	69	25.05
1956	75.9	69	21.23	1979	77.0	68	16.93
1957	76.0	72	24.22				
1958	75.3	70	35.02	1980	77.5	69	26.90
1959	76.7	70	14.14	1981	77.1	72	13.41
				1982	76.9	56	34.92
1960	76.7	70	12.07	1983	77.2	64	5.03
1961	77.2	81	14.26	1984	78.1	71	17.08
1962	76.5	71	13.58	1985	76.9	69	17.38
1963	76.7	64	37.91	1986	78.3	77	13.93
1964	77.0	63	20.12	1987	77.9	73	23.53
1965 1/	76.1	74	42.78	1988	78.5	75	16.47
1966 1/	77.6	68	23.18	1989	77.5	79	27.52
1967 1/	77.6	58	34.34				
1968 1/	77.9	63	37.26	1990	77.6	77	19.84
1969 1/	77.4	68	22.50	1991	77.7	67	17.94
				1992	77.8	(NA)	19.00
1970 1/	78.2	72	15.49	1993	77.1	88	5.84
1971 1/	76.1	70	26.64	1994	78.8	89	15.59
1972	76.2	65	26.94	1995	79.3	89	13.60

NA Not available.

1/ Site conditions produced distorted temperature measurements from 1965 to 1971.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii* (annual, 1950-1995).

**Table 5.38-- AVERAGE DAILY TEMPERATURE AND DAYS WITH MAXIMUM OF 90° OR HIGHER; FOR HONOLULU INTERNATIONAL AIRPORT: 1971 TO 1995**

Year	Average daily maximum (°F.)	Days 90° or higher	Year	Average daily maximum (°F.)	Days 90° or higher
1971	82.7	-	1984	85.5	63
1972	83.2	3	1985	84.6	53
1973	84.4	10	1986	86.2	64
1974	85.0	25	1987	85.7	93
1975	83.6	1	1988	86.1	70
1976	84.1	9	1989	85.2	34
1977	85.2	16	1990	84.0	47
1978	84.2	13	1991	84.9	35
1979	84.7	51	1992	85.2	28
1980	84.6	22	1993	84.5	23
1981	84.6	9	1994	85.5	85
1982	83.5	27	1995	86.8	116
1983	85.1	44			

Source: National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii* (annual report, 1971-1995).

**Table 5.39-- CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT:  
ANNUALLY, 1985 TO 1995**

Year	Average temperature (°F)			Extreme temp. (°F)		Precipitation (inches)
	Annual	Coolest month	Warmest month	Lowest	Highest	
1985	76.9	71.4	81.9	54	93	17.38
1986	78.3	72.6	82.9	56	94	13.93
1987	77.9	71.2	82.9	55	94	23.53
1988	78.5	73.1	82.1	57	94	16.47
1989	77.5	72.9	81.9	56	92	27.52
1990	77.6	71.5	82.3	57	93	19.84
1991	77.7	72.4	82.4	55	93	17.94
1992	77.8	72.9	82.2	58	92	19.00
1993	77.1	70.9	81.3	54	93	5.84
1994	78.8	72.0	84.3	56	95	15.59
1995	79.3	73.4	83.4	56	94	13.60

  

Year	Relative humidity (percent)		Wind speed (miles/hour)		Percent of possible sunshine	Days with precipitation .01 inch or more
	8 A.M.	2 P.M.	Annual average	Peak gust		
1985	72	55	10.6	46	69	87
1986	74	55	10.1	41	77	88
1987	70	54	9.9	41	73	99
1988	71	53	9.8	39	75	88
1989	72	55	10.5	41	79	82
1990	69	54	11.2	46	77	109
1991	69	53	10.0	39	67	86
1992	71	55	9.5	49	(NA)	98
1993	70	53	10.9	46	88	76
1994	72	55	11.9	51	89	80
1995	74	57	10.7	41	89	81

NA Not available.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii* (annual).

**Table 5.40-- CLIMATIC DATA FOR THE PERIOD OF RECORD**

<b>Subject</b>	<b>Date</b>	<b>Place</b>	<b>Magnitude</b>
Long-term averages:			
Lowest monthly average minimum temp. (°F.)	February	Mauna Kea summit	23.5
Lowest monthly average daily temp. (°F.)	February	Mauna Kea summit	31.3
Highest monthly average maximum temp. (°F.)	September	Kawaihae 1/	91.9
Highest monthly average daily temp. (°F.)	September	Kawaihae 1/	80.8
Lowest average annual rainfall (inches)		Kawaihae	8.7
Highest average annual rainfall (inches)		Waialeale	444
Single events:			
Lowest temperature of record (°F.)	Jan. 20, 1970	Mauna Kea summit 2/	1.4
Highest temperature of record (°F.)	April 27, 1931	Pahala	100
Lowest annual rainfall of record (inches)	1953	Kawaihae	0.2
Highest annual rainfall of record (inches)	1982	Waialeale	666
Highest wind speed of record (m.p.h.)	Sept. 11, 1992	Makahuena Pt. 3/	143

1/ Puukohola Heiau National Historical Site, Kawaihae, Hawaii.

2/ Recorded by Dr. Alfred Woodcock 60 meters inside the Mauna Kea summit cone, at 6:50 a.m. The rim at that time had a temperature of 39°F.

3/ Makahuena Point Coast Guard Station, Poipu, Kauai.

Source: Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, Climatological Section, data supplied February 14, 1995.

**Table 5.41-- RAINFALL AT SPECIFIED LOCATIONS: ANNUALLY,  
1985 TO 1995**

[In inches]

Year	Hawaii				Maui		
	Hilo Airport	Waimea 1/	Kona Village	Naalehu	Kahului Airport	Kihei	Lahaina
1985	112.96	16.58	8.60	48.74	20.00	13.86	13.48
1986	171.03	34.67	12.41	64.55	18.39	7.25	7.38
1987	142.41	19.43	10.24	49.13	24.31	14.03	19.72
1988	140.19	12.52	11.70	38.21	26.79	17.03	14.91
1989	166.71	(NA)	13.32	74.79	40.63	27.00	26.95
1990	211.22	23.54	19.80	89.83	35.20	19.17	19.84
1991	153.04	15.73	8.88	44.45	16.09	6.62	11.11
1992	119.89	12.72	9.90	40.57	16.98	11.03	9.73
1993	114.49	20.67	5.91	40.56	12.69	5.82	11.76
1994	182.81	11.87	4.62	63.34	13.93	5.61	8.02
1995	85.92	6.04	5.72	26.55	13.45	8.21	6.30

  

Year	Oahu				Kauai		
	Waikiki	University of Hawaii	Nuuanu Res. 4	Kane-ohe 2/	Koloa	Lihue Airport	Princeville
1985	25.61	42.19	101.20	(NA)	48.70	28.91	55.22
1986	22.39	32.39	120.60	77.66	64.64	27.99	90.28
1987	27.56	46.52	134.29	77.79	72.53	42.95	94.61
1988	24.50	(NA)	124.42	81.10	63.23	43.06	77.10
1989	(NA)	39.53	129.50	88.20	87.81	56.77	116.65
1990	26.15	40.66	137.81	131.69	73.27	39.37	86.44
1991	26.10	42.83	115.02	90.59	71.30	41.63	82.01
1992	(NA)	35.10	118.58	(NA)	52.53	50.17	(NA)
1993	16.92	24.14	81.62	63.55	52.98	22.27	48.02
1994	20.16	33.68	125.48	77.34	60.73	32.99	72.15
1995	12.25	20.98	99.26	67.78	56.76	46.57	86.94

NA Not available.

1/ Lalamilo Field Office.

2/ Hawaii State Hospital (Kaneohe Mauka). The August 1990 value is for a comparable station (Pali Golf Course).

Source: U.S. Department of Commerce, National Climatic Data Center, *Climatological Data, Annual Summary, Hawaii and Pacific* (annual); and Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, records.

**Table 5.42-- MAJOR HURRICANES: 1950 TO 1995**

[Complete to February 14, 1995]

Hurricane name	Date 1/	Islands most affected	Maximum recorded winds ashore (m.p.h.)		Deaths	Property damage (mil. dol.)
			Sustained	Peak gusts		
Hiki	Aug. 15-17, 1950	Kauai	68	(NA)	1	0.2
Della	Sept. 4, 1957	French Frig. Shoals	82	109	-	Minor
Nina	Dec. 1-2, 1957	Kauai	(NA)	92	1	0.1
Dot	Aug. 6, 1959	Kauai	81	103	-	5.5+
Fico	July 18-20, 1978	Hawaii	(NA)	58+	-	0.2
Iwa	Nov. 23, 1982	Kauai, Oahu	65	117	1	234.0
Estelle	July 22, 1986	Maui, Hawaii	(NA)	55	-	2.0
Iniki	Sept. 11, 1992	Kauai, Oahu	92	143	8	1,900

NA Not available.

1/ Period affecting the Hawaiian Islands.

Source: Samuel L. Shaw, *A History of Tropical Cyclones in the Central North Pacific and the Hawaiian Islands, 1832-1979* (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, September 1981); Hawaii State Department of Defense, Civil Defense Division, *Catalogue of Natural and Man-Caused Incidents and Disasters in the Hawaiian Islands* (December 1978); The Governor's Ad Hoc Committee on the Economic Impact of Hurricane Iwa, *Hurricane Iwa's Economic Impact on Hawaii* (January 1983); "The History of Hurricanes in Hawaii," *Honolulu Star-Bulletin*, July 18, 1983, p. A-5; "20-Foot Waves Hit Big Isle As Storm Brushes Coastline," *The Honolulu Advertiser*, July 23, 1986, pp. A1, A2; "Hawaii Hurricanes," *Honolulu Star-Bulletin*, August 4, 1988, p. A-8; Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, data provided February 14, 1995.

**Table 5.43-- TRADE WINDS, HIGH SURF, AND TEMPERATURES IN  
HAWAIIAN WATERS, BY MONTHS**

Month	Trade wind frequency 1/ (percent)	Expected days of strong trade winds 2/	Highest surf 3/ (average number of days)		Water temperature 4/ (°F.)	
			Flat or 1 foot	6 feet or more	Mean maximum	Mean minimum
Jan.	42	9	1	19	74.7	71.1
Feb.	55	7	1	16	75.6	70.3
March	61	10	1	12	76.5	71.8
April	74	10	3	7	77.7	73.0
May	86	7	8	3	79.5	74.7
June	91	7	15	-	81.1	77.7
July	95	10	16	-	81.1	78.3
Aug.	94	7	15	-	81.9	79.2
Sept.	83	4	10	2	81.9	78.4
Oct.	71	4	1	12	81.1	77.2
Nov.	64	8	-	19	79.3	74.5
Dec.	57	9	-	20	75.9	71.4
Annual	73	92	71	110	78.6	74.8

1/ Mean monthly frequency of trade winds in Hawaiian waters.

2/ Expected number of hazardous days in Hawaiian waters due to strong trade winds.

3/ Observations at Sunset Beach, Oahu. Annual averages were: flat or 1 foot, 71 days; 2-5 feet, 184 days; 6-10 feet, 71 days; 11-15 feet, 26 days; 16 feet or higher, 13 days.

4/ Observations at Kaneohe, Oahu. The mean ranged from 73.0 in January and February to 80.2 in August. Absolute maximums and minimums were respectively 84 (in July, August, and October) and 68 (December and February).

Source: Paul Haraguchi, *Weather in Hawaiian Waters* (Honolulu: Pacific Weather, Inc., 1979), pages 14, 22, 56, and 74; Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, data provided February 14, 1995.

**Table 5.44-- AVERAGE WATER TEMPERATURES AT WAIKIKI BEACH**

[In Fahrenheit degrees]

<b>Month</b>	<b>Morning</b>	<b>Afternoon</b>
March	75	77
August	77	82

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii, 1983.*

**Table 5.45-- SUNRISE, SUNSET, AND HOURS OF DAYLIGHT AT SELECTED LOCATIONS, AT BEGINNING OF EACH SEASON: 1997**

[Hawaiian Standard Time]

<b>Subject</b>	<b>Hilo</b>	<b>Kahului</b>	<b>Honolulu</b>	<b>Lihue</b>	<b>Barking Sands</b>
Sunrise (A.M.):					
March 20	6:24	6:29	6:35	6:41	6:42
June 20	5:42	5:45	5:50	5:55	5:56
Sept. 22	6:09	6:15	6:21	6:26	6:28
Dec. 21	6:51	6:58	7:05	7:12	7:14
Sunset (P.M.):					
March 20	6:32	6:37	6:43	6:49	6:51
June 20	7:02	7:10	7:16	7:23	7:25
Sept. 22	6:16	6:21	6:27	6:33	6:35
Dec. 21	5:47	5:50	5:55	6:00	6:01
Hours of daylight:					
March 20	12:08	12:08	12:08	12:08	12:09
June 20	13:20	13:25	13:26	13:28	13:29
Sept. 22	12:07	12:06	12:06	12:07	12:07
Dec. 21	10:56	10:52	10:50	10:48	10:47

Source: Nautical Almanac Office, U.S. Naval Observatory, Tables of Sunrise and Sunset, No. 1083 and 1084, and records; Bishop Museum Planetarium, records.

**Table 5.46-- "LAHAINA" (SHADOWLESS) NOONS FOR SELECTED LOCATIONS:  
1997 TO 1999**

[Lahaina (or shadowless) noons occur when the sun is directly overhead at a specified location]

Location	Lahaina Noon	
	May	July
Honolulu:		
1997	May 26	July 15
1998	27	16
1999	27	16
Time	12:28 PM	12:37 PM
Kahului:		
1997	May 24	July 18
1998	24	19
1999	24	19
Time	12:22 PM	12:31 PM
Lihue:		
1997	May 31	July 11
1998	31	11
1999	31	11
Time	12:23 PM	12:31 PM
Hilo:		
1997	May 18	July 24
1998	18	24
1999	19	24
Time	12:17 PM	12:27 PM

Source: Bishop Museum Planetarium, records.

**Table 5.47-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF THE  
HONOLULU AREA: 1991 TO 1994**

[Counts are made in late December, in a circle, 15 miles in diameter, centered near Nuuanu Pali]

Species	1991	1992	1993	1994
All species:				
Species	46	48	45	49
Individual birds	17,864	18,779	22,598	20,112
Endemic species: 1/				
'Apapane	158	57	145	153
Hawaiian Coot	15	10	81	64
Hawaiian Stilt	99	77	137	388
Oahu 'Amakihi	66	79	136	118
Indigenous species: 2/				
Great Frigatebird	30	50	126	33
Red-footed Booby	472	287	916	1,640
Alien species: 3/				
Cattle Egret	486	202	258	235
Common Myna	2,536	2,698	2,725	2,527
Common Waxbill	290	323	559	856
House Sparrow	954	776	672	392
Japanese White-eye	658	697	931	913
Java Sparrow	2,724	2,702	3,216	2,053
Red-vented Bulbul	1,125	1,309	1,487	2,302
Rock Dove	263	299	327	79
Spotted Dove	1,228	1,513	1,379	1,259
Zebra (Barred) Dove	3,592	4,112	5,627	3,506
Visitor species: 4/				
Pacific Golden-Plover	1,037	1,199	1,332	1,201
Ruddy Turnstone	147	245	357	422

1/ Birds peculiar to Hawaii, and found nowhere else.

2/ Native to Hawaii, but also found elsewhere.

3/ Formerly termed "introduced." Includes accidental escapes from captivity.

4/ Formerly termed "migratory." Includes stragglers and seasonal migrants.

Source: Hawaii Audubon Society, *'Elepaio* (monthly), and records.

**Table 5.48-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF THE  
HONOLULU AREA, BY TYPE OF SPECIES: 1993 AND 1994**

[See headnote and footnotes to the preceding table]

Type of species	Number of species		Number of individuals	
	Dec. 19, 1993	Dec. 18, 1994	Dec. 19, 1993	Dec. 18, 1994
All species	45	49	22,598	20,112
Endemic	6	7	513	801
Indigenous	8	7	1,143	1,721
Alien	22	29	19,114	15,936
Visitor	9	6	1,828	1,654

Source: Hawaii Audubon Society, records.

**Table 5.49-- TREES ALONG STREETS OR IN PARKS UNDER THE  
JURISDICTION OF THE CITY AND COUNTY OF HONOLULU: 1991 TO 1996**

[As of June 30]

<b>Location</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994 2/</b>	<b>1995</b>	<b>1996</b>
Along City and County streets and highways 1/	125,236	127,056	130,458	131,817	132,286	134,270
In City and County parks	98,599	98,685	99,025	99,412	100,377	101,063

1/ Excludes Federal, State, and private thoroughfares.

2/ Revised.

Source: City and County of Honolulu, Department of Parks and Recreation, records.

**Table 5.50-- ESTIMATED NUMBER OF SPECIES IN HAWAII: 1995**

[Excludes viruses and bacteria]

<b>Category</b>	<b>Species</b>
Total in Hawaii and surrounding waters	21,383
Endemic to Hawaii	8,759
Nonindigenous protists, fungi, plants, and animals	4,532
Terrestrial	15,000
Found in fresh water	300
Marine-inhabiting	5,500

Source: Lucius G. Eldredge and Scott E. Miller, "How many species are there in Hawaii?", *Bishop Museum Occasional Papers*, No. 41, March 1, 1995, pp. 3-18.

**Table 5.51-- THREATENED AND ENDANGERED SPECIES, FOR THE  
UNITED STATES AND HAWAII: 1995**

<b>Geographic area</b>	<b>Total</b>	<b>Bird</b>	<b>Mammal</b>	<b>Plant</b>	<b>Snail</b>
Hawaii	273	31	2	199	41
Niihau	8	1	1	6	-
Kauai	83	13	2	68	-
Oahu	129	7	2	79	41
Molokai	59	6	1	52	-
Lanai	42	4	1	37	-
Kahoolawe	4	-	-	4	-
Maui	78	12	2	64	-
Hawaii	67	14	2	51	-
United States	...	88	...	526	...

Source: *National Geographic*, September 1995, pp. 14-15.