Atlas of Hawaiian Watersheds & Their Aquatic Resources: An important tool to aid in statewide stream and watershed management

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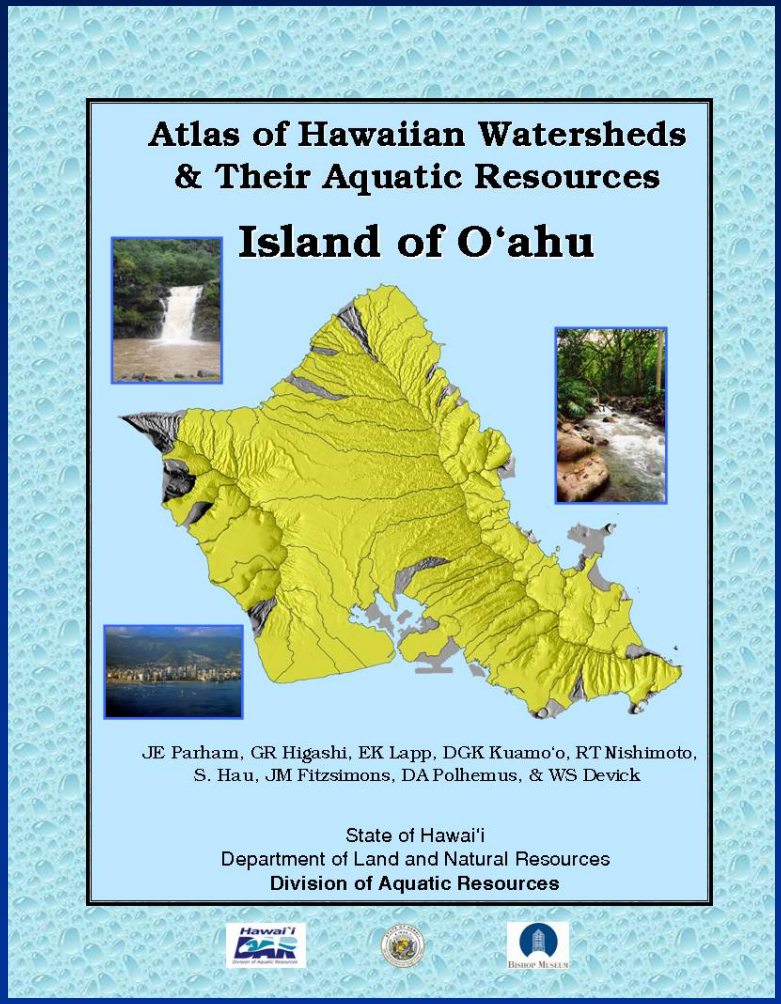
Important elements in stream management

- Information on watershed characteristics
- Stream biological data
- Hydrological data
- Stream database that can be linked with other data sources to assist in solving questions on stream ecosystem-watershed interactions

Watershed Atlas is a collaboration between Hawai'i Division of Aquatic Resources[1] and Bishop Museum[2]



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Watershed Atlas

Main Hawaiian Islands:

Kauai, Oahu, Molokai, Maui and Hawaii

Contains 430 watersheds

Criteria: Perennial and non-perennial streams w/1 survey or greater than 1 kilometer in length.

Data Source: DAR Aquatic Surveys Database v2.6

Date Period: 1893 – Present

90,704 different species observations

13,254 different surveys (HDF&G, point quadrat, line transect, larval trapping, impoundment, microhabitat, rapid bio-assessment (RAS), and general observations & field notes)

Contents of the Watershed Atlas

- Introduction
- Key to information in the Watershed Atlas
- Legend
- Island Introduction
- Bibliography
- Region Partitions
  - Watersheds
- Appendix 1

Atlas Introduction

Purpose:

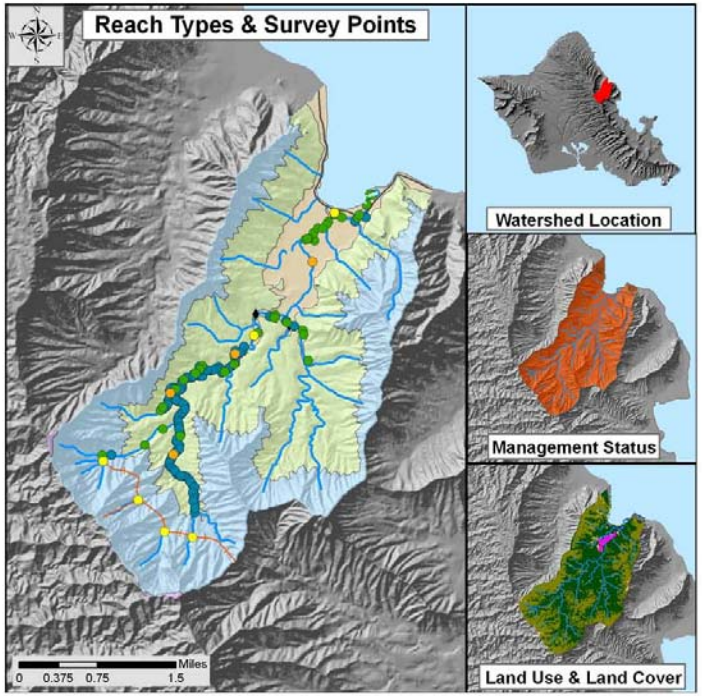
- Make stream data available to researchers, resource managers, and general public
- Comparative information on what is known about each stream
- Baseline information for management of streams statewide
- Platform to link other data sources to aquatic resources data for *ahupua'a* management
- Create a "living document" that can be updated with new Information

Watershed

- Watershed Features
  - Land Stewardship
  - Land Stewardship
  - Land Management Status
  - Land Use
- Stream Features
  - Reach Type Percentages
- Biotic Sampling Effort
  - Distribution of Sampling
- Biota Information
- Historic Rankings
- Current Watershed and Stream Ratings
  - Watershed rating
  - Biological
  - Overall
- References

DAR Watershed Code: 31018

Kahana, O'ahu



WATERSHED FEATURES

Kahana watershed occurs on the island of O'ahu. The Hawaiian meaning of the name is "cutting". The area of the watershed is 8.5 square mi (22.1 square km), with maximum elevation of 2641 ft (805 m). The watershed's DAR cluster code is 4, meaning that the watershed is medium size, steep in the upper watershed, and with embayment. The percent of the watershed in the different land use districts is as follows: 0.9% agricultural, 98.2% conservation, 0% rural, and 0.9% urban.

Land Stewardship: Percentage of the land in the watershed managed or controlled by the corresponding agency or entity. Note that this is not necessarily ownership.

Military	Federal	State	OHA	County	Nature Conservancy	Other Private
0.1	0.0	94.4	0.0	3.0	0.0	2.5

GRH1 Glenn R. Higashi, 5/20/2008

Stream Features

Biotic Sampling Effort

Land Management Status: Percentage of the watershed in the categories of biodiversity protection and management created by the Hawaii GAP program.

Permanent Biodiversity Protection	Managed for Multiple Uses	Protected but Unmanaged	Unprotected
0.0	0.0	97.5	2.5

Land Use: Areas of the various categories of land use. These data are based on NOAA C-CAP remote sensing project.

	Percent	Square mi	Square km
High Intensity Developed	0.0	0.00	0.00
Low Intensity Developed	1.0	0.09	0.23
Cultivated	0.0	0.00	0.00
Grassland	0.7	0.06	0.14
Scrub/Shrub	40.3	3.44	8.91
Evergreen Forest	56.1	4.80	12.42
Palustrine Forested	0.0	0.00	0.00
Palustrine Scrub/Shrub	0.0	0.00	0.00
Palustrine Emergent	1.1	0.10	0.25
Estuarine Forested	0.0	0.00	0.00
Bare Land	0.1	0.01	0.03
Unconsolidated Shoreline	0.1	0.01	0.03
Water	0.5	0.04	0.10
Unclassified	0.0	0.00	0.00

STREAM FEATURES

Kahana is a perennial stream. Total stream length is 18.4 mi (29.7 km). The terminal stream order is 3.

Reach Type Percentages: The percentage of the stream's channel length in each of the reach type categories.

Estuary	Lower	Middle	Upper	Headwaters
4.2	0.0	70.7	25.2	0.0

The following stream(s) occur in the watershed:

Huilua fishpond, Kahana, Kāwā, Keaniani, Pu'upiei

BIOTIC SAMPLING EFFORT

Biotic samples were gathered in the following year(s):

1961, 1969, 1970, 1980, 1990, 1995, 2000, 2002, 2003, 2006

Biota Information

Kahana, O'ahu

Distribution of Biotic Sampling: The number of survey locations that were sampled in the various reach types.

Survey type	Estuary	Lower	Middle	Upper	Headwaters
Damselfly Surveys	1	3	0	5	0
DAR Observation	0	0	2	0	0
DAR Point Quadrat	0	18	231	2	0
DAR Rapid BioAssessment	1	1	0	0	0
HDFG	0	1	3	0	0
Published Report	18	11	15	1	0

BIOTA INFORMATION

Species List

Native Species		Native Species	
Crustaceans	*Atyoida bisulcata*	**Insects**	*Campsicnemus brevipes*
	Grapsus tenuicrustatus		*Dasyhelea hawaiiensis*
	Macrobrachium grandimanus		*Limonia jacobus*
	Macrobrachium sp.		*Megalagrion hawaiiense*
	Metopograpsus thukuhar		*Megalagrion leptodemas*
	Palaemon debilis		*Megalagrion nigrohamatum nigrolineatum*
	Palaemon pacificus		
	Palaemon sp.		*Megalagrion sp.*
	Podophthalmus vigil		*Microvelia vagans*
	Portunus sanguinolentus		*Saldula exulans*
	Thalamita crenata		*Scatella cilipes*
Fish	*Abudefduf abdominalis*		*Scatella clavipes*
	Abudefduf sordidus		*Scatella oahuense*
			Tipulidae sp.
			Acanthurus triostegus
	Acanthurus xanthopterus		
	Albula sp.		
	Arothron hispidus		
	Atherinomorus insularum		
	Awaous guamensis		
	Bathygobius cocosensis		
	Bothus mancus		
	Bothus pantherinus		
	Carangidae sp.		
	Carangoides ferdau		
	Caranx ignobilis		
	Diodon holocanthus		
	Diodon hystrix		
	Eleotris sandwicensis		
	Epinephelus sp.		
	Fistularia commersonii		
	Gobiidae sp.		

Kahana, O'ahu

Species Size Data: Species size (inches) observed in DAR Point Quadrat Surveys.

Scientific Name	Status	Minimum Size	Maximum Size	Average Size
Ranidae sp.	Introduced	2	2	2.0
Atyoida bisulcata	Endemic	1	2.5	1.4
Macrobrachium lar	Introduced	1	10	3.2
Kuhlia xenura	Endemic	2.5	4	3.2
Lentipes concolor	Endemic	3	3	3.0
Sicyopterus stimpsoni	Endemic	1.5	2.75	2.3
Stenogobius hawaiiensis	Endemic	3.25	4	3.8
Awaous guamensis	Indigenous	1	7.5	3.3
Gobiidae sp.	Indigenous	1	1	1.0
Poecilia reticulata	Introduced	0.5	2	1.0
unidentified poeciliidae	Introduced	1	1	1.0
Xiphophorus helleri	Introduced	1	4.25	1.8
no species observed	No	3.25	3.25	3.3
Neritina granosa	Endemic	1.5	2	1.8

Average Density: The densities (#/square yard) for species observed in DAR Point Quadrat Surveys averaged over all sample dates in each reach type.

Scientific Name	Status	Estuary	Low	Mid	Upper	Headwaters
Atyoida bisulcata	Endemic			0.11	0.06	
Kuhlia xenura	Endemic			0.02		
Lentipes concolor	Endemic				0.03	
Neritina granosa	Endemic			0.01		
Sicyopterus stimpsoni	Endemic			0.01	0.03	
Stenogobius hawaiiensis	Endemic		0.24			
Awaous guamensis	Indigenous			0.06	0.22	
Gobiidae sp.	Indigenous			0.01		
Macrobrachium lar	Introduced		0.3	0.72	0.06	
Poecilia reticulata	Introduced		2.04			
Ranidae sp.	Introduced		0.18			
unidentified poeciliidae	Introduced		0.06			
Xiphophorus helleri	Introduced		3.3	0.23		

Species Distributions: Presence (P) of species in different stream reaches.

Scientific Name	Status	Estuary	Lower	Middle	Upper	Headwaters
Atyoida bisulcata	Endemic	P	P	P	P	
Macrobrachium	Endemic	P	P	P		
Eleotris sandwicensis	Endemic	P	P	P		
Kuhlia xenura	Endemic	P	P	P		
Lentipes concolor	Endemic				P	
Oxyurichthys lonchotus	Endemic	P				

Historic Rankings

Crocothemis servilia	Introduced		P	
Culex pervigilans	Introduced			P
Hydroptila potosina	Introduced			P
Ischnura ramburi	Introduced			P
Orthemis ferruginea	Introduced		P	
Pantala flavescens	Introduced			P
Melania sp.	Introduced		P	P
Physidae sp.	Introduced		P	P
Palaemon sp.	Undetermined	P		
Albula sp.	Undetermined	P		
Epinephelus sp.	Undetermined	P		
Tipulidae sp.	Undetermined			P
Hirudinea sp.	Undetermined		P	P
Oligochaete sp.	Undetermined		P	P
Macrobrachium sp.	Unknown		P	

HISTORIC RANKINGS

Historic Rankings: These are rankings of streams from historical studies. "Yes" means the stream was considered worthy of protection by that method. Some methods include non-biotic data in their determination. See Atlas Key for details.

Multi-Attribute Prioritization of Streams - Potential Heritage Streams (1998): No

Hawaii Stream Assessment Rank (1990): Outstanding

U.S. Fish and Wildlife Service High Quality Stream (1988): No

The Nature Conservancy- Priority Aquatic Sites (1985): No

National Park Service - Nationwide Rivers Inventory (1982): No

Current DAR Decision Rule Status: The following criteria are used by DAR to consider the biotic importance of streams. "Yes" means that watershed has that quality.

Native Insect Diversity > 19 spp.	Native Macrofauna Diversity > 5 spp.	Absence of Priority 1 Introduced
No	Yes	No
Abundance of Any Native Species	**Presence of Candidate Endangered Species**	**Endangered Newcomb's Snail Habitat**
No	Yes	No

Watershed Ratings

- Land Cover
- Shallow water
- Stewardship

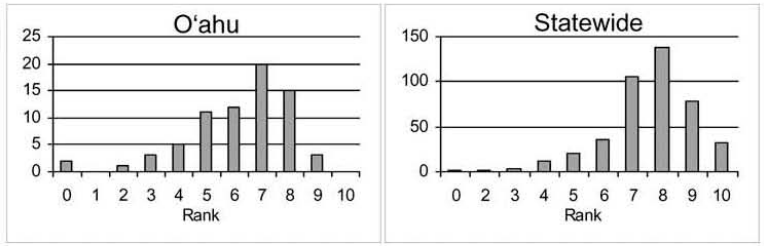
CURRENT WATERSHED AND STREAM RATINGS

The current watershed and stream ratings are based on the data contained in the DAR Aquatic Surveys Database. The ratings provide the score for the individual watershed or stream, the distribution of ratings for that island, and the distribution of ratings statewide. This allows a better understanding of the meaning of a particular ranking and how it compares to other streams. The ratings are standardized to range from 0 to 10 (0 is lowest and 10 is highest rating) for each variable and the totals are also standardized so that the rating is not the average of each component rating. These ratings are subject to change as more data are entered into the DAR Aquatic Surveys Database and can be automatically recalculated as the data improve. In addition to the ratings, we have also provided an estimate of the confidence level of the ratings. This is called rating strength. The higher the rating strength the more likely the data and rankings represent the actual condition of the watershed, stream, and aquatic biota.

WATERSHED RATING: Kahana, O'ahu

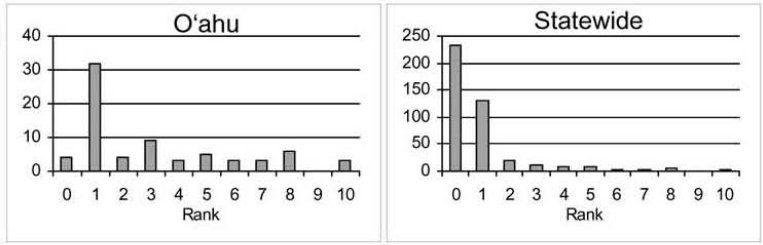
Land Cover Rating: Rating is based on a scoring sytem where in general forested lands score positively and developed lands score negatively.

Watershed Rating
9



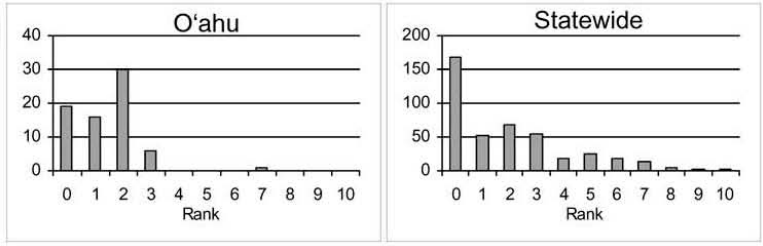
Shallow Waters Rating: Rating is based on a combination of the extent of estuarine and shallow marine areas associated with the watershed and stream.

Watershed Rating
4



Stewardship Rating: Rating is based on a scoring system where higher levels of land and biodiversity protection within the watershed score positively.

Watershed Rating
3



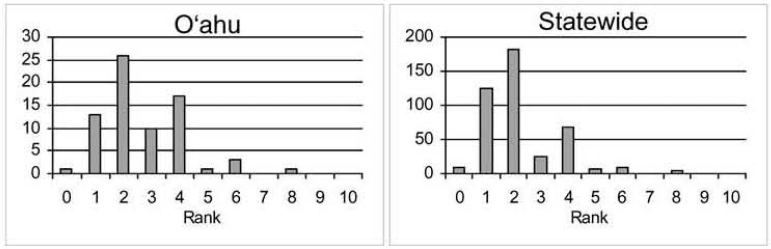
Watershed Ratings (continued)

- Size
- Wetness
- Reach diversity
- Total Watershed

WATERSHED RATING (Cont): Kahana, O'ahu

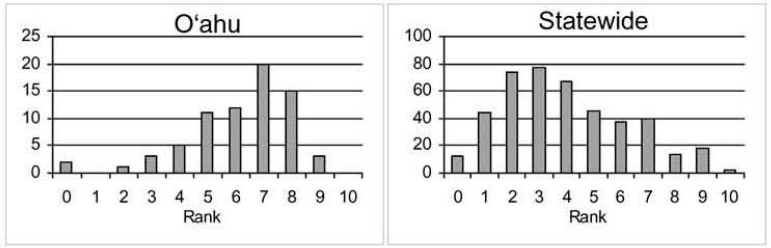
Size Rating: Rating is based on the watershed area and total stream length. Larger watersheds and streams score more positively.

Watershed Rating 4



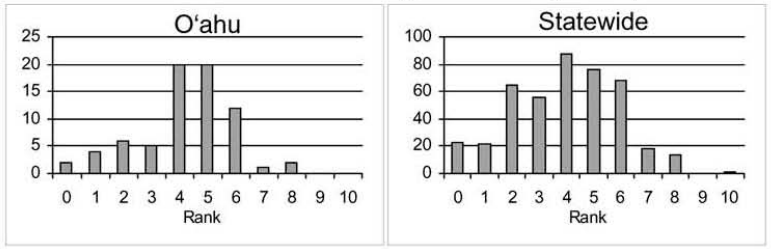
Wetness Rating: Rating is based on the average annual rainfall within the watershed. Higher rainfall totals score more positively.

Watershed Rating 5



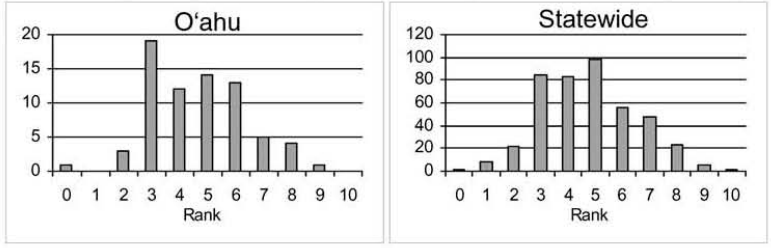
Reach Diversity Rating: Rating is based on the types and amounts of different stream reaches available in the watershed. More area in different reach types score more positively.

Watershed Rating 5



Total Watershed Rating: Rating is based on combination of Land Cover Rating, Shallow Waters Rating, Stewardship Rating, Size Rating, Wetness Rating, and Reach Diversity Rating.

Watershed Rating 7



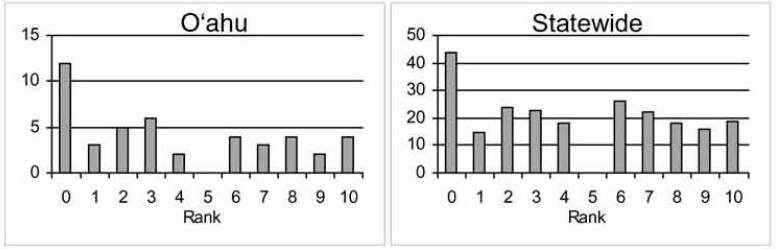
Biological Rating

- Native Species
- Introduced Species
- All Species Score
- Total Biological

BIOLOGICAL RATING: Kahana, O'ahu

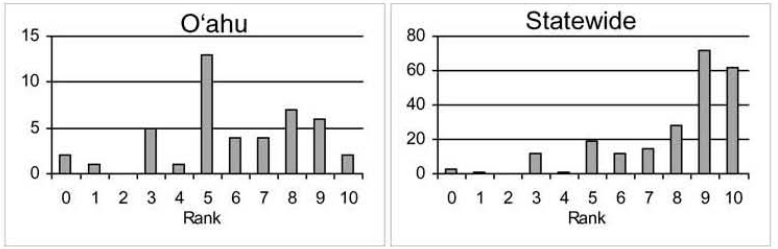
Native Species Rating: Rating is based on the number of native species observed in the watershed.

Stream Rating 10



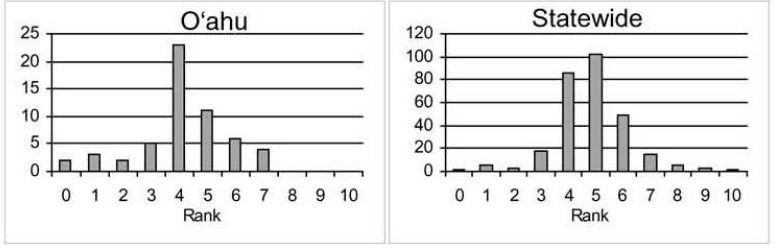
Introduced Genera Rating: Rating is based on the number of introduced genera observed in the watershed.

Stream Rating 1



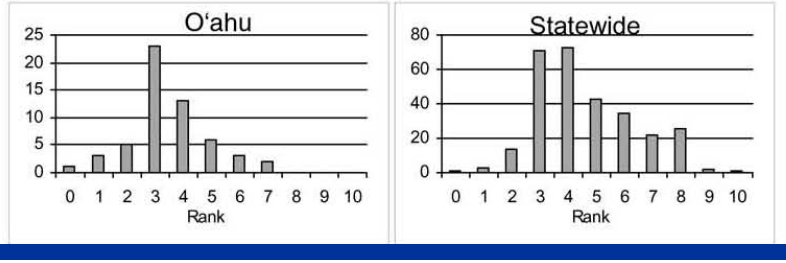
All Species' Score Rating: Rating is based on the Hawaii Stream Assessment scoring system where native species score positively and introduced species score negatively.

Stream Rating 7



Total Biological Rating: Rating is the combination of the Native Species Rating, Introduced Genera Rating, and the All Species' Score Rating.

Stream Rating 5



Overall Rating

Total Watershed + Total Biological

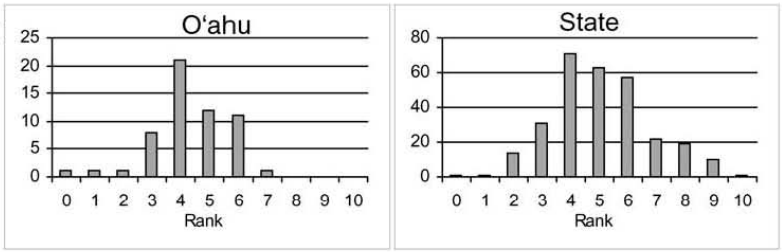
Rating Strength

OVERALL RATING: Kahana, O'ahu

Overall Rating: Rating is a combination of the Total Watershed Rating and the Total Biological Ranting.

Watershed Rating

6

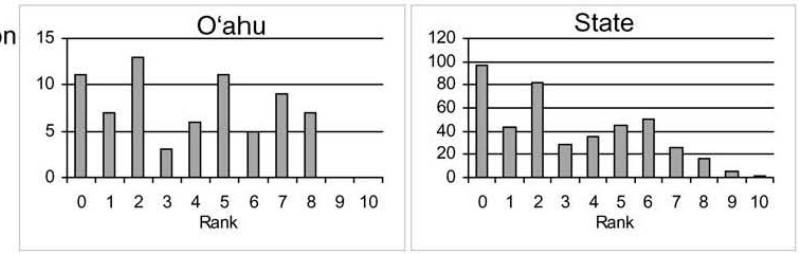


RATING STRENGTH: Kahana, O'ahu

Rating Strength: Represents an estimate of the overall study effort in the stream and is a combination of the number of studies, number of different reaches surveyed, and the number of different survey types.

Information Rating

8



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1972. Maciolek, J.A. Diadromous Macrofauna and the Kahana Stream-Estuary Ecosystem.

1980. Archer, K.M., A.S.Timbol and J.D. Parrish. Biological Survey of Kahana Stream System. Hawaii Cooperative Fishery Research Unit Technical Report 80-2. 1980.

1981. Maciolek, J.A. Consumer Trophic Relations in a Tropical Insular Estuary. Bulletin of Marine Science, 31 (3). 702-711.

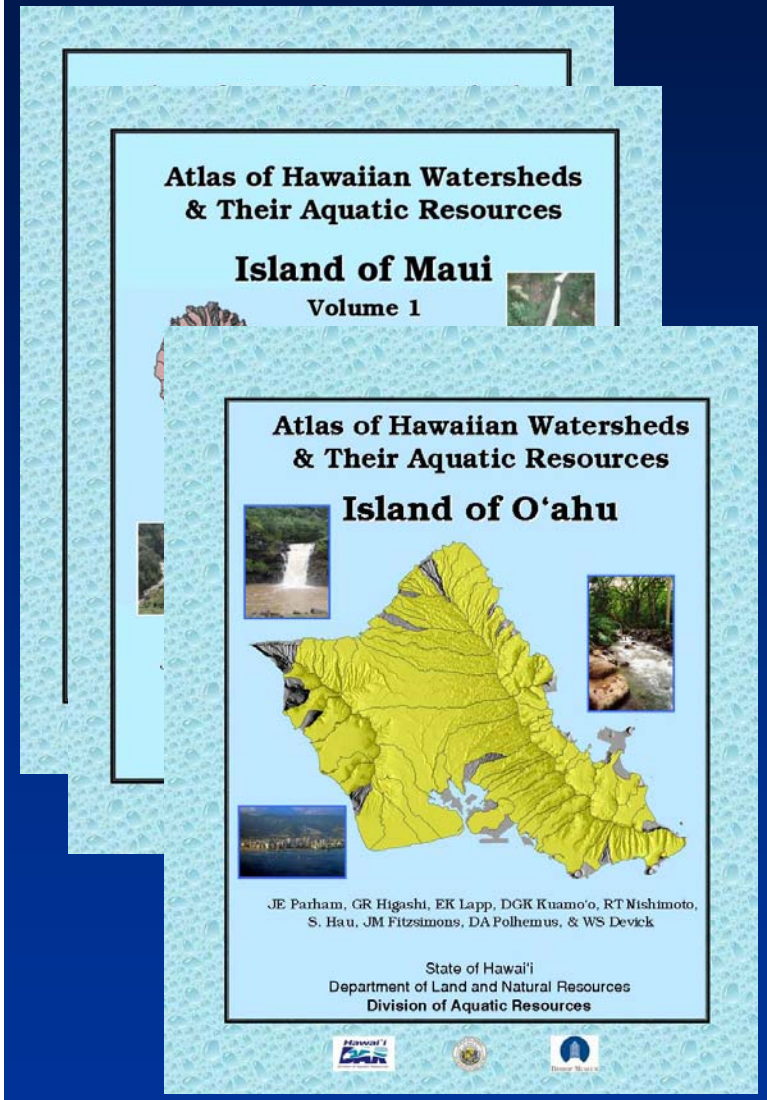
Management Applications within DLNR

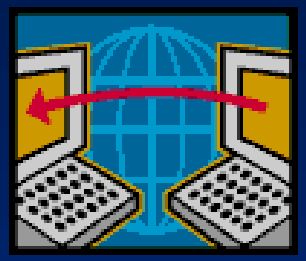
- DOFAW and Land Division - Linking stream conditions with terrestrial resources and land use
- State Parks - Helping with planning and management
- CWRM – Providing biological data for instream flow issues and stream alterations

Management Applications outside of DLNR

- University researchers
- Federal agencies (USGS, EPA, USACE)
  USFWS – National Fish Habitat Action Plan -
  Hawaii Fish Habitat Partnership
- DOH, Clean Water Branch - TMDLs and stream water quality issues
- BWS – Ahupua'a management
- TNC – conservation planning, monitoring, and management
- Bishop Museum – research and education
- Watershed Group Partnerships – information, education, monitoring, and management
- General Public - information and education

Watershed Atlas Availability





WEB version
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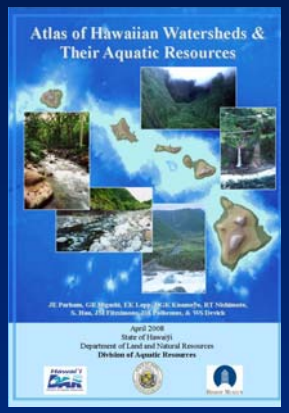

DVD version
(couple months)

Hard Copy version
(Limited copies based upon
printing costs)
10 volumes
4,507 pages

Watershed Atlas Information

- Websites to get GIS layers, DAR stream information, and Watershed Atlas:
- http://www.hawaii.gov/dbedt/gis/download.htm
- http://www.hawaii.gov/dlnr/dar/streams/streamdata.htm
- http://www.hawaiiwatershedatlas.com
- Email address: dlnr.ar.stream@hawaii.gov

Mahalo