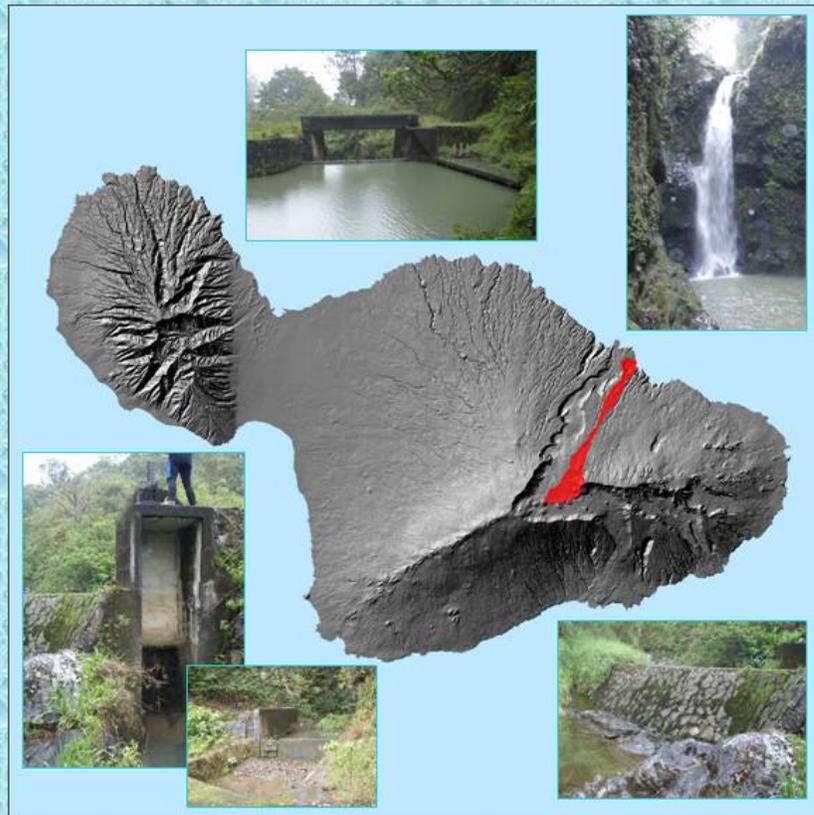


Report on Wailuanui Stream Maui, Hawaii



June 2008

State of Hawai'i
Department of Land and Natural Resources
Division of Aquatic Resources



Report on Wailuanui Stream Maui, Hawai'i

June 2008

Prepared for
Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawai'i

Prepared by
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Section 1: Overview

Introduction:

This report is an accounting of the aquatic resources that have been observed in Wailuanui Stream, Maui. The report was generated to provide some information to aid in the instream flow determination for the East Maui Streams at the request of the Commission on Water Resource Management (CWRM). The focus of this report is the animals that live in the stream and the data collected during surveys of the stream. The report covers six main sections, including:

- Overview
- Watershed Atlas Report
- DAR Point Quadrat Survey Report
- DAR Insect Survey Report
- An Analysis of Depth Use vs. Availability
- Photographs of stream taken during stream surveys

The overview provides the introduction for the purpose of this report, a summary of the findings on the stream and its animals, and a discussion of the importance of the findings and how stream conditions influence native species populations. The Watershed Atlas Report provides a description of the watershed and its aquatic resources from Division of Aquatic Resources (DAR) and other published and unpublished surveys as well as a rating of the condition of the stream compared to other streams on Maui as well as statewide. The DAR Point Quadrat Survey Report describes the distribution, habitats, and species observed during the standardized DAR stream surveys. The DAR Insect Survey Report describes the distribution, habitats, and species of insects observed in the stream. The analysis of depth use vs. availability looks at habitat use by the native species and the availability of suitable depths in the stream. Finally, the photographs provide context to the conditions that the stream surveyors encountered in the stream.

This overview reports on the highlights of these findings and provides a discussion of the importance of the information presented. We hope that this format provides the reader with a simplified, general discussion and understanding of the condition of Wailuanui Stream while also providing substantial evidence to support the conclusions presented.

Findings for Wailuanui Stream, Maui:

Wailua Nui is the name of the land division while Wailuanui is the name of the stream. Wailua Nui is a moderately small (6.6 square miles), narrow watershed. It is mostly zoned conservation (92%) and agricultural (8%) and the land cover is mostly evergreen forest (39%), bare ground (34%), scrub (18%), and grassland (9%). Numerous stream surveys have been completed in Wailuanui Stream beginning in 1962 to the present. This watershed rates above average in comparison to other watersheds on Maui and statewide.

It has a total watershed rating of 7 out of 10, a total biological rating of 8 out of 10, and a combined overall rating of 8 out of 10.

Native species observed in the stream include the following categories and species:

Fish - *Awaous guamensis*, *Eleotris sandwicensis*, *Kuhlia sp.*, *Lentipes concolor*, and *Sicyopterus stimpsoni*.

Crustaceans - *Atyoida bisulcata* and *Macrobrachium grandimanus*

Mollusks - *Neritina granosa*, and *Neritina vespertina*

Introduced species observed in this stream includes the following categories and species:

Crustaceans - *Macrobrachium lar* and *Procambarus clarkii*

Mollusks - *Lymnea sp.* and *Pomacea sp.*

Amphibian – *Rana rugosa*

Limited effort in surveying native insects was done in this stream and no insects were observed in the recent upper reach surveys. In historic surveys the native dragonflies and damselflies were observed as well as introduced chironomids.

The native animals were observed using sites with deeper water. This is consistent with findings statewide. The diversions resulted in an increase frequency of dry or shallow sites as compared to streams statewide. The decreased available water as a result of stream diversions is likely restricting native adult animal habitat.

Photographs were only taken in the upper reach near upstream diversions in Wailuanui Stream. These photographs illustrate that most of the water is removed by the diversions in the upper reaches of the stream and its tributaries.

Discussion for Wailuanui Stream, Maui:

Wailuanui stream flows into the ocean through a sandy boulder beach. There is a high scenic waterfall next to Hana Highway. Most of the water is diverted in this stream and the water diversion structures are quite large and remove all of the flow at normal discharge rates. Water is collected at the base of the waterfall and used for irrigation of Wailua taro patches (lo'i). Taro has been cultivated continuously over a hundred years in this watershed.

This stream rates better than average for streams on Maui and statewide. This is likely a result of the range of habitats present and the number of different native species observed in this stream. The stream lacks many of the commonly introduced species and thus has a relatively intact native biota.

Many native fishes and macroinvertebrates are present in this stream. This is a positive sign that habitat exists and the lower reach has nearly continuous flow to the ocean. The presence of *Kuhlia sp.* suggests that the connection with the ocean is relatively large and

consistent. Analysis of depth availability suggests that some habitat exists, but more of the stream is shallower than suitable for the native animals.

Limited effort in surveying native insect was done in this stream and no insects were observed in the upper reach surveys. In historic surveys the native dragonflies and damselflies were observed as well as introduced chironomids.

Larval recruitment has been observed at the mouth of this stream. At the base of the first waterfall the water flows into a boulder field and flows through the boulders back to the stream. Skippy Hau has observed postlarval fish move upstream past the taro patch drainage into the stream and not into the taro patch. This could be the result of the differences in water temperatures between the taro field water and the stream water. During the day, water is heated by the exposed taro fields while the stream is covered by a riparian vegetative canopy.

In the lower and middle reaches most of the drifting larvae should make it to the ocean. Only in the upper reach does the diversion remove all the water and would likely entrain most larvae present at that elevation.

Crayfish and Lymnaeid snails were observed in this stream in the lower reach. These animals are likely also found in the diversions or taro patches.

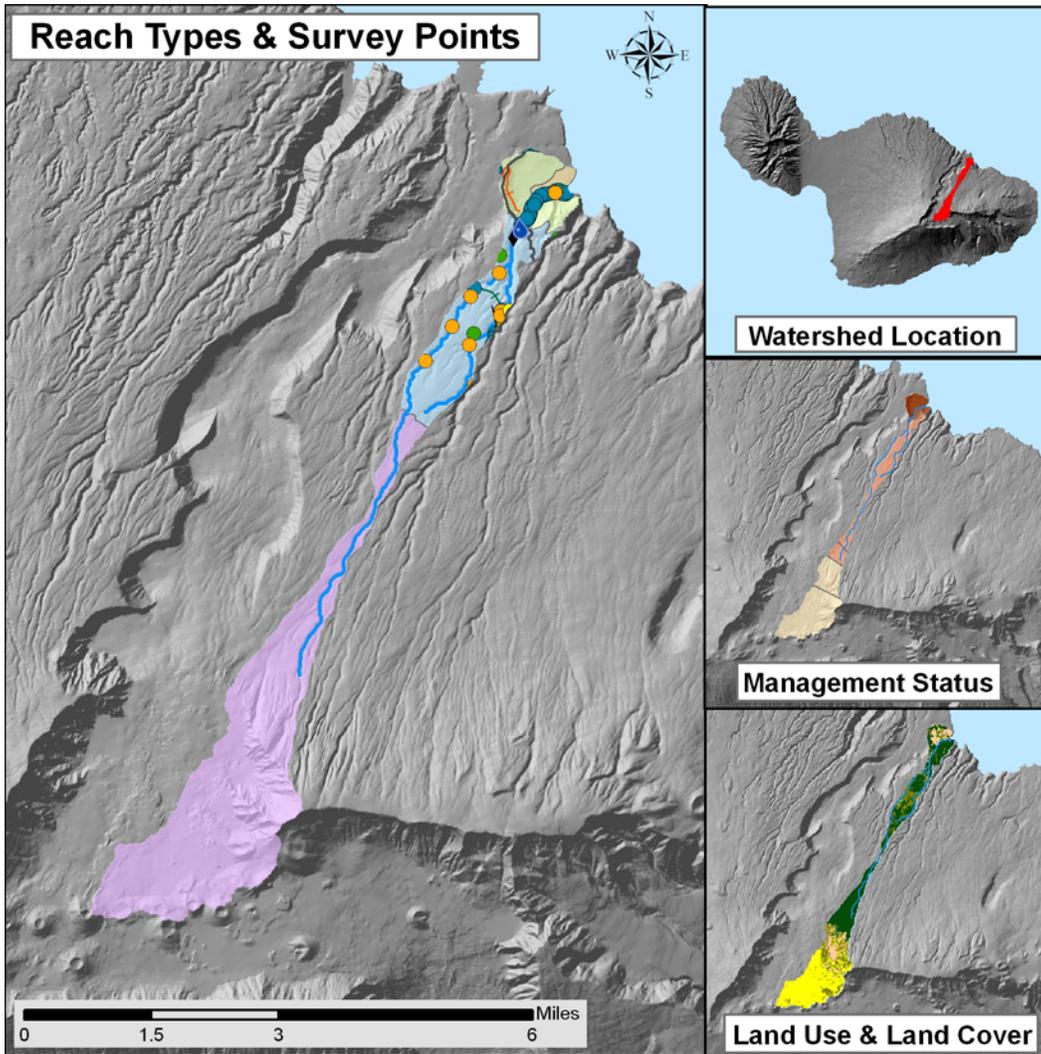
This stream has connectivity in the lower and middle reaches of the stream. Only the upper reach is disconnected by the diversion ditch and structures. As a result, a number of native amphidromous animals still inhabit this stream

The water diversions reduce the overall stream flow, but do not completely dewater the lower reach of this stream. The upper diversion removes all the water in both of the tributaries, but the stream gains water downstream. The continuous stream discharge in the lower and middle reaches supports a wide range of native species.

Section 2: Watershed Atlas Report



Wailua Nui, Maui



WATERSHED FEATURES

Wailua Nui watershed occurs on the island of Maui. The Hawaiian meaning of the name is “big Wailua”. The area of the watershed is 6.6 square mi (17 square km), with maximum elevation of 8858 ft (2700 m). The watershed’s DAR cluster code is 2, meaning that the watershed is small, steep in the upper watershed, and with little embayment. The percent of the watershed in the different land use districts is as follows: 7.6% agricultural, 92.4% conservation, 0% rural, and 0% 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.

<u>Military</u>	<u>Federal</u>	<u>State</u>	<u>OHA</u>	<u>County</u>	<u>Nature Conservancy</u>	<u>Other Private</u>
0.0	39.8	35.7	0.0	0.0	14.9	9.6

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

Permanent Biodiversity <u>Protection</u>	Managed for Multiple <u>Uses</u>	Protected but <u>Unmanaged</u>	<u>Unprotected</u>
54.7	35.7	0.0	9.6

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

	<u>Percent</u>	<u>Square mi</u>	<u>Square km</u>
High Intensity Developed	0.0	0.00	0.00
Low Intensity Developed	0.0	0.00	0.00
Cultivated	0.0	0.00	0.00
Grassland	9.4	0.62	1.61
Scrub/Shrub	17.6	1.16	3.00
Evergreen Forest	38.7	2.54	6.58
Palustrine Forested	0.0	0.00	0.00
Palustrine Scrub/Shrub	0.0	0.00	0.00
Palustrine Emergent	0.0	0.00	0.00
Estuarine Forested	0.0	0.00	0.00
Bare Land	34.2	2.25	5.82
Unconsolidated Shoreline	0.0	0.00	0.00
Water	0.1	0.01	0.02
Unclassified	0.0	0.00	0.00

STREAM FEATURES

Wailuanui is a perennial stream. Total stream length is 9.6 mi (15.4 km). The terminal stream order is 2.

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

<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
0.0	5.1	5.7	52.0	37.1

The following stream(s) occur in the watershed:

East Wailunui Wailunui West Wailunui

BIOTIC SAMPLING EFFORT

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

1962 1979 1980 1992 2002 2003 2007
2008

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

<u>Survey type</u>	<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
DAR General Surveys	0	1	0	0	0
DAR Observation	0	1	0	0	0
DAR Point Quadrat	0	36	25	5	0
HDFG	0	1	0	7	0
Published Report	0	1	0	2	0

BIOTA INFORMATION**Species List****Native Species**

Crustaceans	<i>Atyoida bisulcata</i> <i>Macrobrachium grandimanus</i>
Fish	<i>Awaous guamensis</i> <i>Eleotris sandwicensis</i> <i>Gobiidae sp.</i> <i>Kuhlia sandwicensis</i> <i>Kuhlia xenura</i> <i>Lentipes concolor</i> <i>Sicyopterus stimpsoni</i>
Snails	<i>Neritina granosa</i> <i>Neritina vespertina</i>

Native Species

Insects	<i>Anax junius</i> <i>Anax sp.</i> <i>Megalagrion sp.</i> <i>Telmatogeton sp.</i>
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Introduced Species

Amphibians	<i>Rana rugosa</i>
Crustaceans	<i>Macrobrachium lar</i> <i>Procambarus clarkii</i>
Snails	<i>Lymnaeid sp.</i> <i>Pomacea sp.</i>

Introduced Species

Insects	<i>Chironomid larvae</i>
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Species Size Data: Species size (inches) observed in DAR Point Quadrat Surveys.

<u>Scientific Name</u>	<u>Status</u>	<u>Minimum Size</u>	<u>Maximum Size</u>	<u>Average Size</u>
<i>Atyoida bisulcata</i>	Endemic	0.25	2	1.1
<i>Macrobrachium grandimanus</i>	Endemic	1.25	1.25	1.3
<i>Macrobrachium lar</i>	Introduced	1	6	2.8
<i>Procambarus clarkii</i>	Introduced	0.5	1	0.8
<i>Eleotris sandwicensis</i>	Endemic	2	3.5	2.8
<i>Kuhlia xenura</i>	Endemic	1	3	2.0
<i>Lentipes concolor</i>	Endemic	0.75	2.5	1.2
<i>Sicyopterus stimpsoni</i>	Endemic	0.75	4	1.6
<i>Awaous guamensis</i>	Indigenous	0.75	8	2.5
<i>Gobiidae</i>	Indigenous	0.75	1	0.9
<i>Neritina granosa</i>	Endemic	0.5	2	1.1
<i>Lymnaeid sp.</i>	Introduced	0.25	0.25	0.3

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

<u>Scientific Name</u>	<u>Status</u>	<u>Estuary</u>	<u>Low</u>	<u>Mid</u>	<u>Upper</u>	<u>Headwaters</u>
<i>Atyoida bisulcata</i>	Endemic				5.48	
<i>Eleotris sandwicensis</i>	Endemic		0.48			
<i>Kuhlia xenura</i>	Endemic		0.64			
<i>Lentipes concolor</i>	Endemic		0.16	0.86		
<i>Macrobrachium grandimanus</i>	Endemic		0.16			
<i>Neritina granosa</i>	Endemic		0.8	0.86		
<i>Sicyopterus stimpsoni</i>	Endemic		0.32	3.24		
<i>Awaous guamensis</i>	Indigenous		0.48	2.38		
<i>Gobiidae.</i>	Indigenous		0.32			
<i>Macrobrachium lar</i>	Introduced		1.93	2.16		
<i>Procambarus clarkii</i>	Introduced		0.32			

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

<u>Scientific Name</u>	<u>Status</u>	<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
<i>Atyoida bisulcata</i>	Endemic		P	P	P	
<i>Macrobrachium grandimanus</i>	Endemic		P			
<i>Eleotris sandwicensis</i>	Endemic		P			
<i>Kuhlia xenura</i>	Endemic		P			
<i>Lentipes concolor</i>	Endemic		P	P	P	
<i>Sicyopterus stimpsoni</i>	Endemic		P	P	P	
<i>Megalagrion sp.</i>	Endemic				P	
<i>Neritina granosa</i>	Endemic		P	P		
<i>Neritina vespertina</i>	Endemic		P			
<i>Awaous guamensis</i>	Indigenous		P	P		
<i>Gobiidae.</i>	Indigenous		P		P	
<i>Kuhlia sandwicensis</i>	Indigenous		P			
<i>Anax junius</i>	Indigenous				P	
<i>Anax sp.</i>	Indigenous				P	
<i>Telmatogeton sp.</i>	Indigenous				P	
<i>Rana rugosa</i>	Introduced		P			
<i>Macrobrachium lar</i>	Introduced		P	P	P	
<i>Procambarus clarkii</i>	Introduced		P			
<i>Chironomid larvae</i>	Introduced		P		P	
<i>Lymnaeid sp.</i>	Introduced		P			
<i>Pomacea sp.</i>	Introduced		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.

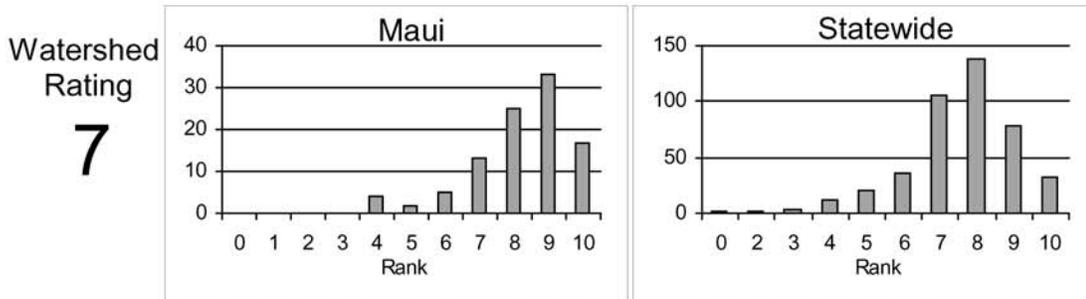
Native Insect Diversity <u>> 19 spp.</u>	Native Macrofauna <u>Diversity > 5 spp.</u>	Absence of Priority 1 <u>Introduced</u>
No	Yes	No
Abundance of Any <u>Native Species</u>	Presence of Candidate <u>Endangered Species</u>	Endangered Newcomb's <u>Snail Habitat</u>
No	No	No

CURRENT WATERSHED AND STREAM RATINGS

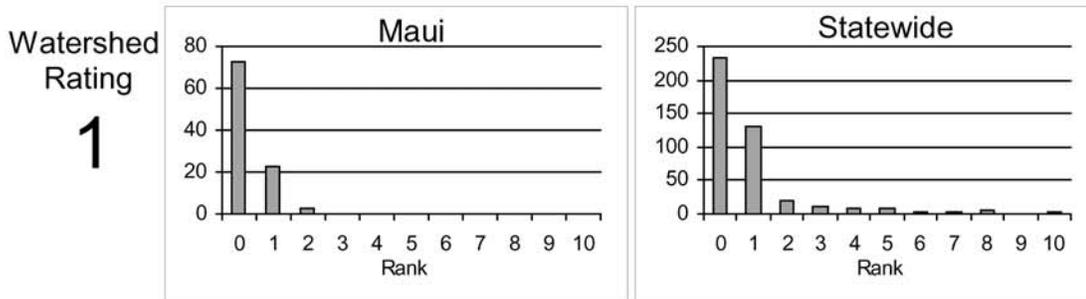
The current watershed and stream ratings are based on the data contained in the DAR Aquatic Surveys Database. The ratings provide the score for the individual watershed or stream, the distribution of ratings for that island, and the distribution of ratings statewide. This allows a better understanding 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: Wailua Nui, Maui

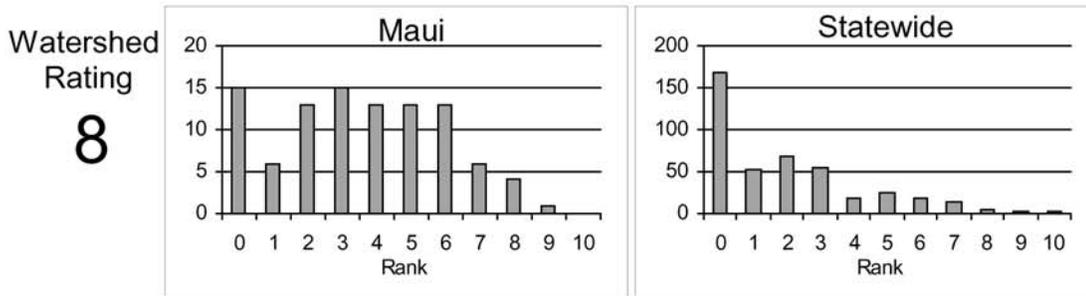
Land Cover Rating: Rating is based on a scoring system where in general forested lands score positively and developed lands score negatively.



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

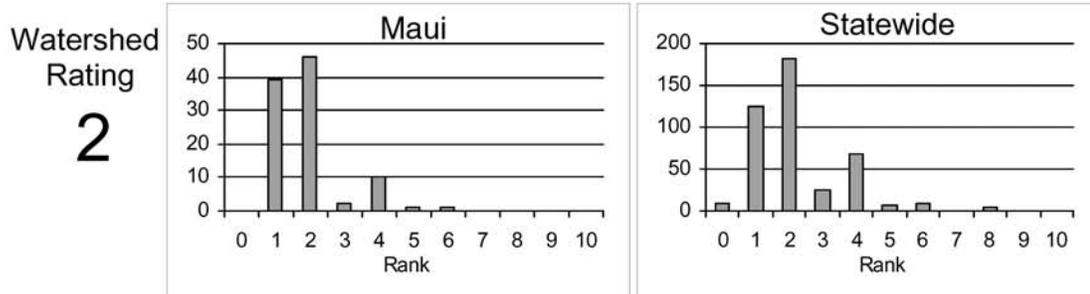


Stewardship Rating: Rating is based on a scoring system where higher levels of land and biodiversity protection within the watershed score positively.

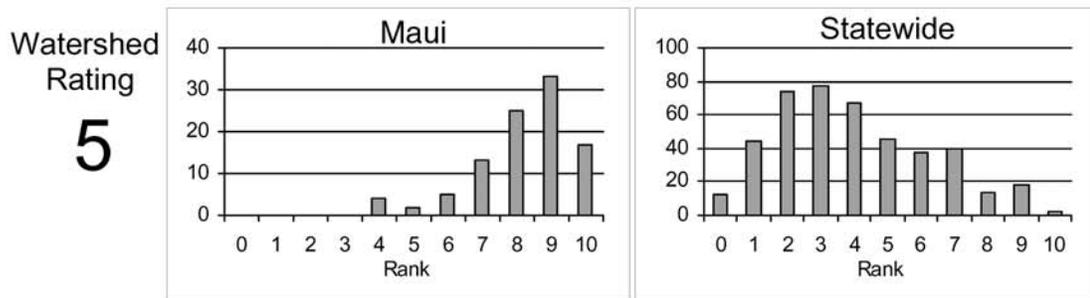


WATERSHED RATING (Cont): Wailua Nui, Maui

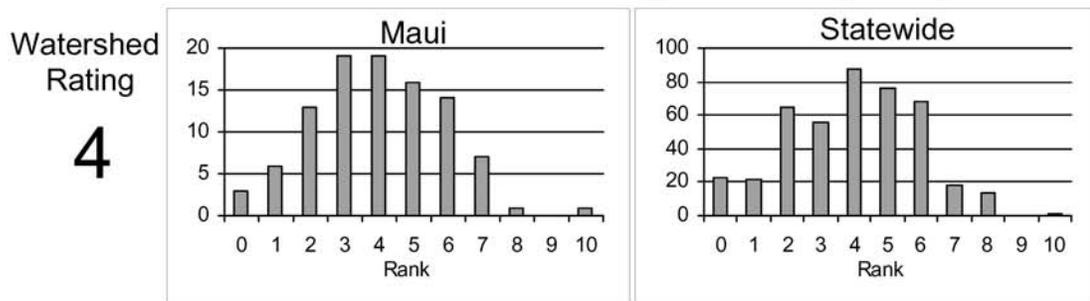
Size Rating: Rating is based on the watershed area and total stream length. Larger watersheds and streams score more positively.



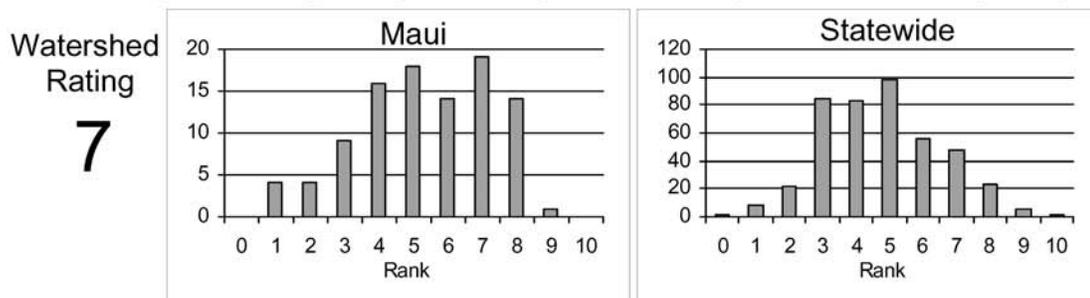
Wetness Rating: Rating is based on the average annual rainfall within the watershed. Higher rainfall totals score more positively.



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.



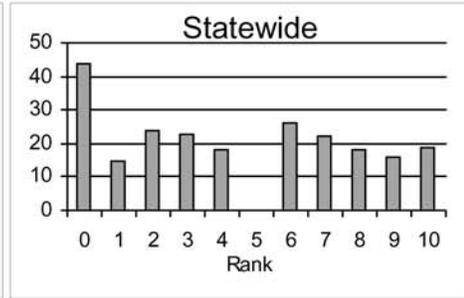
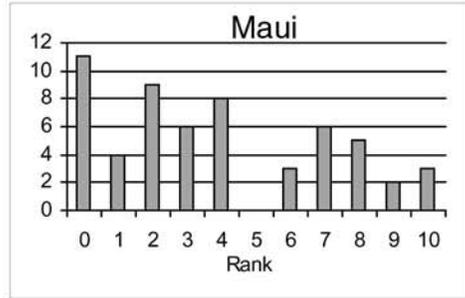
Total Watershed Rating: Rating is based on combination of Land Cover Rating, Shallow Waters Rating, Stewardship Rating, Size Rating, Wetness Rating, and Reach Diversity Rating.



BIOLOGICAL RATING: Wailua Nui, Maui

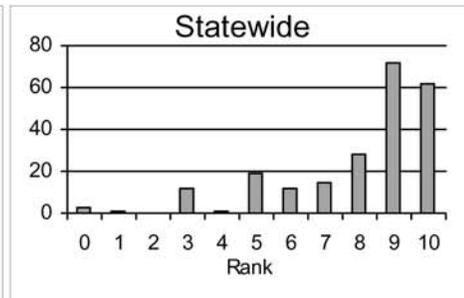
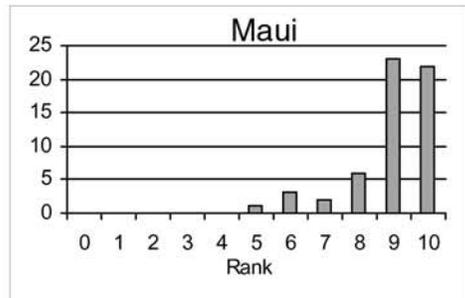
Native Species Rating: Rating is based on the number of native species observed in the watershed.

Stream Rating
9



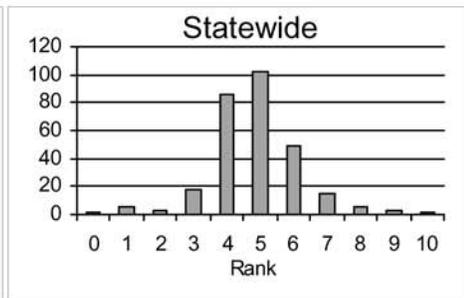
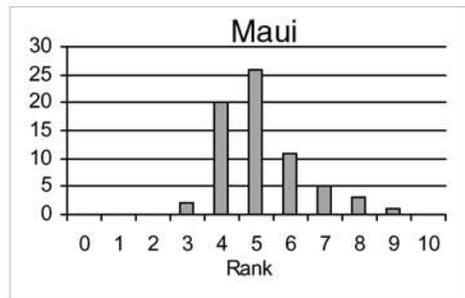
Introduced Genera Rating: Rating is based on the number of introduced genera observed in the watershed.

Stream Rating
9



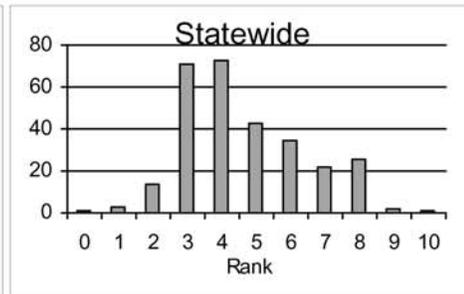
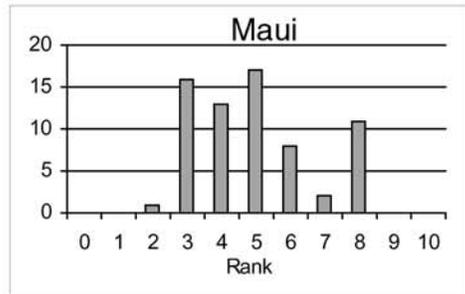
All Species' Score Rating: Rating is based on the Hawaii Stream Assessment scoring system where native species score positively and introduced species score negatively.

Stream Rating
6



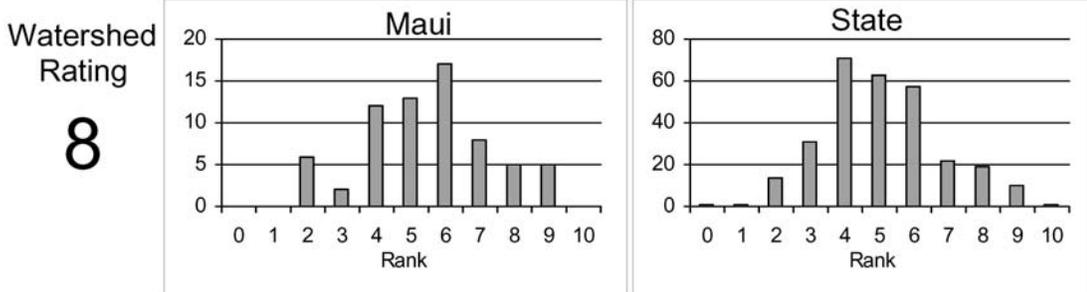
Total Biological Rating: Rating is the combination of the Native Species Rating, Introduced Genera Rating, and the All Species' Score Rating.

Stream Rating
8



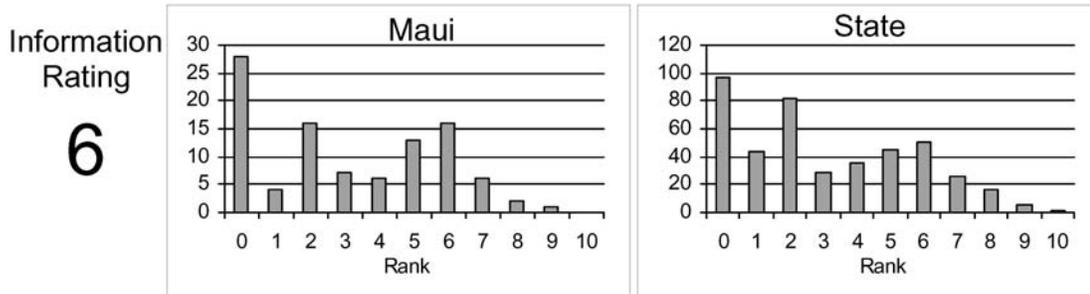
OVERALL RATING: Wailua Nui, Maui

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



RATING STRENGTH: Wailua Nui, Maui

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.



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1980. Parrish, J.D. Numerical equivalents of biological data in the Lentipes report.

1980. Timbol, A.S., Sutter, A.J. and J.D. Parrish. Distribution and Relative Abundance of the Endemic Freshwater Goby, *Lentipes concolor* in Hawaii. Hawaii Cooperative Fishery Research Unit.

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1992. Hau, S. Site Inspection of West Wailuanui Stream.
2005. Gingerich, S.B. and R.H. Wolff. Effects of Surface-Water Diversions on Habitat Availability for Native Macrofauna, Northeast Maui, Hawaii.
2008. Hawai'i Division of Aquatic Resources. DAR Point Quadrat Survey Data from the DAR Aquatic Surveys Database.

Appendix 1: Scientific and Common Names

Appendix 1: Scientific and Common Names (continued)

CN = Common Name and HN = Hawaiian Name

Amphibian

Introduced

Rana rugosa

CN: wrinkled frog; HN: none.

Crustacean

Endemic

Atyoida bisulcata

CN: Mountain opae; HN: `opae kala`ole.

Macrobrachium grandimanus

CN: Hawaiian prawn; HN: opae 'oeha'a.

Introduced

Macrobrachium lar

CN: none; HN: none.

Procambarus clarkii

CN: none; HN: none.

Fish

Endemic

Eleotris sandwicensis

CN: Hawaiian sleeper; HN: `O`opu akupa.

Kuhlia xenura

CN: Hawaiian flagtail (Hoover, 1993, 2003; Randall, 1996a), Mountain bass (DLNR); HN: aholehole.

Lentipes concolor

CN: `O`opu alamo`o; HN: `O`opu alamo`o.

Sicyopterus stimpsoni

CN: `O`opu nōpili; HN: `O`opu nopili.

Indigenous

Awaous guamensis

CN: none; HN: `O`opu nakea.

Gobiidae sp.

CN: unidentified goby; HN: none.

Kuhlia sandwicensis

CN: ; HN: none.

Insect

CN = Common Name and HN = Hawaiian Name

Endemic

Megalagrion sp.

CN: damselfly larvae; HN: none.

Indigenous

Appendix 1: Scientific and Common Names (continued)

CN = Common Name and HN = Hawaiian Name

Anax junius

CN: none; HN: none.

Anax sp.

CN: none; HN: none.

Telmatogeton sp.

CN: diptera cocoon; HN: none.

Telmatogeton sp.

CN: diptera larvae; HN: none.

Introduced

Chironomid larvae

CN: none; HN: none.

Snail

Endemic

Neritina granosa

CN: none; HN: Hihiwai or wi.

Neritina vespertina

CN: none; HN: Hapawai or Hapakai.

Introduced

Lymnaeid sp.

CN: none; HN: none.

Pomacea sp.

CN: none; HN: none.

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Section 3: DAR Point Quadrat Survey Report

DAR Point Quadrat Survey Report for Wailuanui, Maui for surveys from 5/1/2002 to 4/3/2008

This Division of Aquatic Resources (DAR) stream surveys report is produced using the Point Quadrat Methodology. Trained biologists and technicians survey a series of randomly located points in a stream to generate an assessment of composition of species and habitats in the stream. The Point Quadrat Methodology is only one of several different techniques that could be chosen for the surveys and is used to develop a statistically comparable stream survey. The following information represents an accounting of the observations that will be used in overall stream management efforts by DAR. . All density measurements are in number of animals per square yard in the reach.

Table 1. The watersheds (and watershed ID), region, and island surveyed in this report are:

Wailuanui (ID: 64014), Ke‘anae, Maui

Table 2. Survey team personnel:

Hau, Skippy
 Higashi, Glenn
 Kuamoo, Darrell
 Leonard, Jason
 Shimoda, Troy

Table 3. The distribution of sites by reach during this survey effort.

<u>Survey Type</u>	<u>Reaches</u>					<u>Total</u>
	<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwater</u>	
Point Quadrat (random)		36	19	3		58

Lower Reach of Wailuanui Stream, Maui:

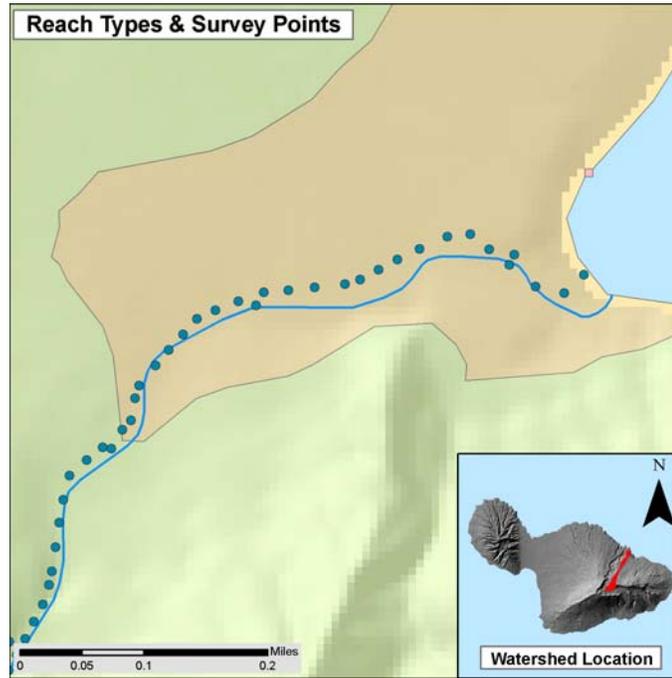


Figure 1. Locations of the Point Quadrat Surveys done in the low reach of Wailuanui Stream. Orange color is the lower reach delineation and dots are the survey locations.

Habitat Types						
<u>Cascade</u>	<u>Riffle</u>	<u>Run</u>	<u>Pool</u>	<u>Plunge</u>	<u>Side pool</u>	<u>No water</u>
1	1	26	1		7	

Substrate Types in Surveys (%)						
<u>Detritus</u>	<u>Sediment</u>	<u>Sand</u>	<u>Gravel</u>	<u>Cobble</u>	<u>Boulder</u>	<u>Bedrock</u>
12	9	5	8	14	34	18

Species Observed						
<u>Category</u>	<u>Status</u>	<u>Scientific Name</u>	<u>Reach</u>	<u>Avg Density</u>	<u>Total # observed</u>	
Crustaceans	Introduced	<i>Macrobrachium lar</i>	Lower	2.15	16	
Crustaceans	Endemic	<i>Macrobrachium grandimanus</i>	Lower	0.13	1	
Crustaceans	Introduced	<i>Procambarus clarkii</i>	Lower	0.54	4	
Fish	Endemic	<i>Sicyopterus stimpsoni</i>	Lower	0.27	2	
Fish	Indigenous	<i>Awaous guamensis</i>	Lower	0.4	3	
Fish	Endemic	<i>Eleotris sandwicensis</i>	Lower	0.4	3	
Fish	Endemic	<i>Kuhlia xenura</i>	Lower	1.61	12	
Fish	Endemic	<i>Lentipes concolor</i>	Lower	0.13		

Fish	Indigenous	<i>Gobiidae</i> sp.	Lower	0.4	3
Snails	Endemic	<i>Neritina granosa</i>	Lower	0.94	7
Snails	Introduced	<i>Lymnaeid</i> sp.	Lower	0.13	1

Middle Reach of Wailuanui Stream, Maui:

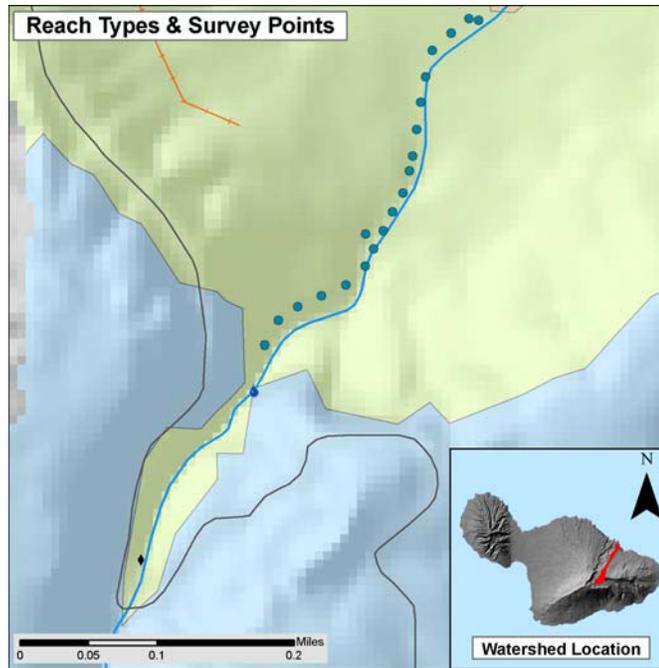


Figure 2. Represents the Point Quadrat Surveys done in the middle reach of Wailuanui Stream. Green is the middle reach delineation and dots are the survey sites.

Habitat Types						
<u>Cascade</u>	<u>Riffle</u>	<u>Run</u>	<u>Pool</u>	<u>Plunge</u>	<u>Side pool</u>	<u>No water</u>
		8	10	2	2	3

Substrate Types in Surveys (%)						
<u>Detritus</u>	<u>Sediment</u>	<u>Sand</u>	<u>Gravel</u>	<u>Cobble</u>	<u>Boulder</u>	<u>Bedrock</u>
8	0	2	5	19	58	8

Species Observed					
<u>Category</u>	<u>Status</u>	<u>Scientific Name</u>	<u>Reach</u>	<u>Avg Density</u>	<u>Total # observed</u>
Crustaceans	Introduced	<i>Macrobrachium lar</i>	Middle	1.21	5
Crustaceans	Endemic	<i>Atyoida bisulcata</i>	Middle	0.48	2
Fish	Endemic	<i>Lentipes concolor</i>	Middle	0.72	3

Fish	Endemic	<i>Sicyopterus stimpsoni</i>	Middle	4.1	17
Fish	Indigenous	<i>Awaous guamensis</i>	Middle	1.69	7
Snails	Endemic	<i>Neritina granosa</i>	Middle	0.97	4

Upper Reach of Wailuanui Stream, Maui:

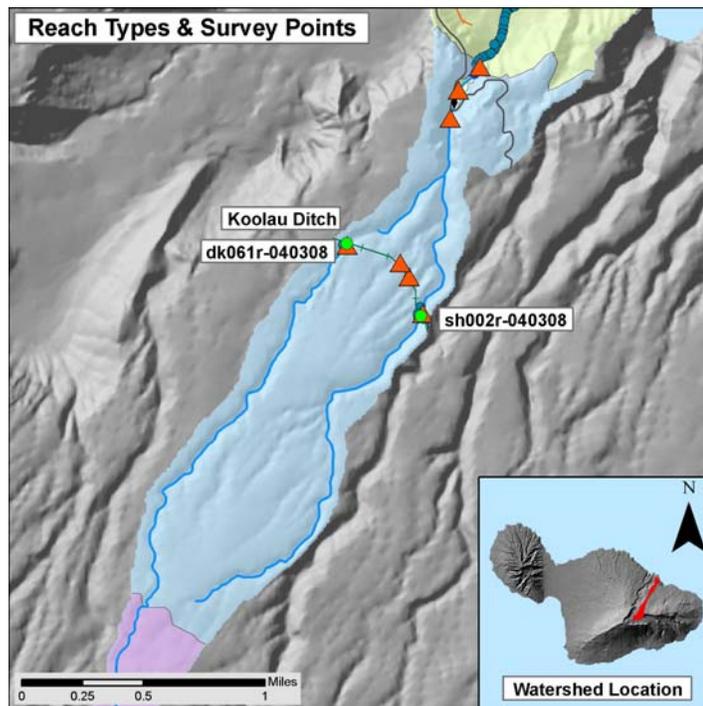


Figure 3. Locations of the Point Quadrat Surveys done in the upper reach of Wailua Nui Stream. Blue areas are the upper reach delineation and dots are survey locations. Labels are for associated pictures.

Habitat Types						
<u>Cascade</u>	<u>Riffle</u>	<u>Run</u>	<u>Pool</u>	<u>Plunge</u>	<u>Side pool</u>	<u>No water</u>
		1	1	1		1

Substrate Types in Surveys (%)						
<u>Detritus</u>	<u>Sediment</u>	<u>Sand</u>	<u>Gravel</u>	<u>Cobble</u>	<u>Boulder</u>	<u>Bedrock</u>
0	0	0	0	15	25	60

Species Observed

No species observed in upper reach

Section 4: DAR Aquatic Insect Report

RECORDS OF AQUATIC INSECTS FROM WAILUANUI STREAM, EAST MAUI WATERSHED

Table 1: Aquatic insect taxa sampled from Wailuanui Stream, Station 1, at Hana Road, 650 ft., water temp. 21° C., 31 January 2000
20°50'09"N, 156°08'27"W

Insect Taxon	Taxon Type
No captures	

Table 2: Aquatic insect taxa sampled from Wailuanui Stream, Station 2, above EMI access road, 1275 ft., 5 October 2001.
20°49'29.3"N, 156°08'41.9"W

Insect Taxon	Taxon Type
No captures	

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Section 5: An Analysis of Depth Use vs. Availability

Introduction:

As part of an ongoing collaboration between the Division of Aquatic Resources and Bishop Museum, we have been analyzing the relationship between instream measures of habitat and the occurrence of native animals. The intention of this research is to better understand the habitat requirements of these animals to improve management of the stream environment. While this research effort is not complete, we have tried to provide some information to aid in the instream flow determination for the East Maui Streams at the request of the Commission on Water Resource Management.

The amount of water in a stream is important to the fishes and macroinvertebrates that inhabit the stream. One measure of the amount of water needed in the stream to create suitable habitat is the depth of the water in a survey site. The deeper areas of a stream may be important to the animals to provide safety from predatory birds, a refuge from fluctuations in discharge, or as a buffer to changes in temperature as larger volumes of water heat or cool more slowly than smaller water volumes. Depth is also closely related to stream discharge. Given a specific stream bed form, increased discharge results in increases in depth and velocity. Conversely, if water is diverted from a stream, the decrease in downstream discharge results in slower, shallower water. Surveyors record the quadrat depth when using the DAR Point Quadrat technique, but do not measure velocity; therefore we used the depth in this analysis.

In this report, we compare the depth measured for each site during the DAR Point Quadrat Surveys of Wailuanui Stream, Maui to the depths where animals were observed. Additionally, we also compared the observations for Wailuanui Stream to depth observations for all streams statewide surveyed using Point Quadrat Surveys to see if the pattern for Wailuanui Stream is consistent with other Hawaiian streams. Finally, the distribution of average site depth by elevation groups is provided.

Methods:

All data reflected in this report came from the DAR Aquatics Surveys Database. For each random survey site in Wailuanui Stream, Maui (Watershed code = 64014) the depth and animals observed were queried from the database. Additionally, the same information was collected for all survey sites statewide.

To compare the depth suitability for the stream animals, availability, utilization, and suitability criteria were developed following standardized procedures (Bovee 1982). In general, this method based habitat utilization on the presence/absence data, and does not take into account site density. Depth availability is the frequency of each depth category based on the distribution of depths observed in the field survey. Percent availability is calculated by dividing the number of observations for a depth category by the total number of observations and multiplying by 100. Utilization is the frequency of occurrence for an individual species in each depth category. Percent utilization is calculated by dividing the number of sites with a species observed for a depth category by the total number of sites with a species observed and multiplying by 100. Suitability

is developed by dividing the percent utilization for each depth category with the percent availability for each depth category. The standardized suitability has the range adjusted so that the largest value for each species equals 1 (suitable) and the lowest value equals 0 (unsuitable).

To compare the site depths observed in the stream to the average site depths statewide, the percent frequency of occurrence for each depth bin was calculated from the data for Wailuanui Stream and for all sites statewide in the DAR Point Quadrat Surveys. Additionally, the difference between the percent frequencies for each depth bin was plotted in a histogram to clearly show where the differences occurred.

To examine where in the stream changes in available depths occurred, the average depth was determined for a number of elevation bins. The determination of the distribution of the elevation bins was influenced by the number of samples in a depth bin. Where possible at least 5 samples were needed to create a depth bin.

Results:

Depth suitability criteria were developed for *Awaous guamensis*, *Neritina granosa*, *Sicyopterus stimpsoni*, and for sites without any animals observed. While the sample size is not large for any of the species (*Awaous guamensis* = 7, *Neritina granosa* = 8, *Sicyopterus stimpsoni* = 10, and for sites without any animals = 22), the pattern of increasing suitability with increasing depth was observed for each species. The pattern of unsuitable habitat for any species at dry or shallow depth was also observed. There was little pattern observed in the few samples for the other native species observed.

The pattern of the distribution of observed depths in Wailuanui Stream in comparison to the statewide average depths reveals that dry and shallow sites (6 inches depth or less) are much more common in Wailuanui than in most Hawaiian Streams (Figure 2). The sample size was 58 sites for Wailuanui Stream in comparison to 6084 sites statewide. There were approximately 26% more dry and shallow sites than observed in the statewide data set (Figure 3). In contrast to the increase in dry sites, there was a decrease in sites 20 inches in depth and deeper.

The distribution of survey sites did not allow an analysis of depth by elevation. Of the 58 sample sites, 51 were at 35 m elevation or less and 3 sample sites were at elevations between 398 and 416 m. Given that the majority of survey locations were at low elevations in this stream, the number of shallow or dry sites would not be expected unless the lower section is a losing reach.

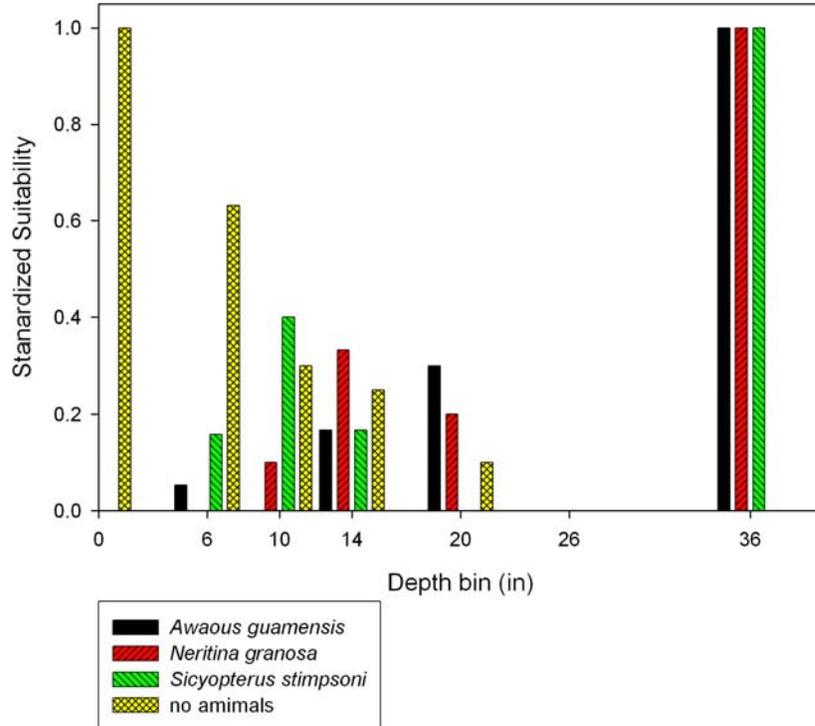


Figure 1. Depth Suitability for animals observed in DAR Point Quadrat Surveys in Wailuanui Stream, Maui.

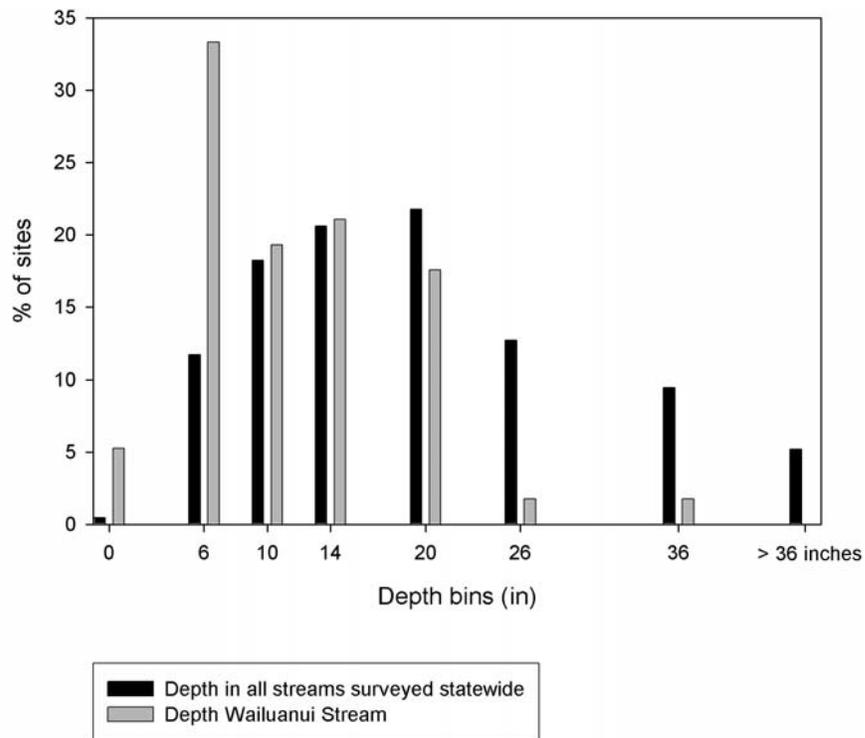


Figure 2. Comparison of percent availability for depth categories between Wailuanui Stream, Maui and all streams statewide in the DAR Aquatics Surveys Database.

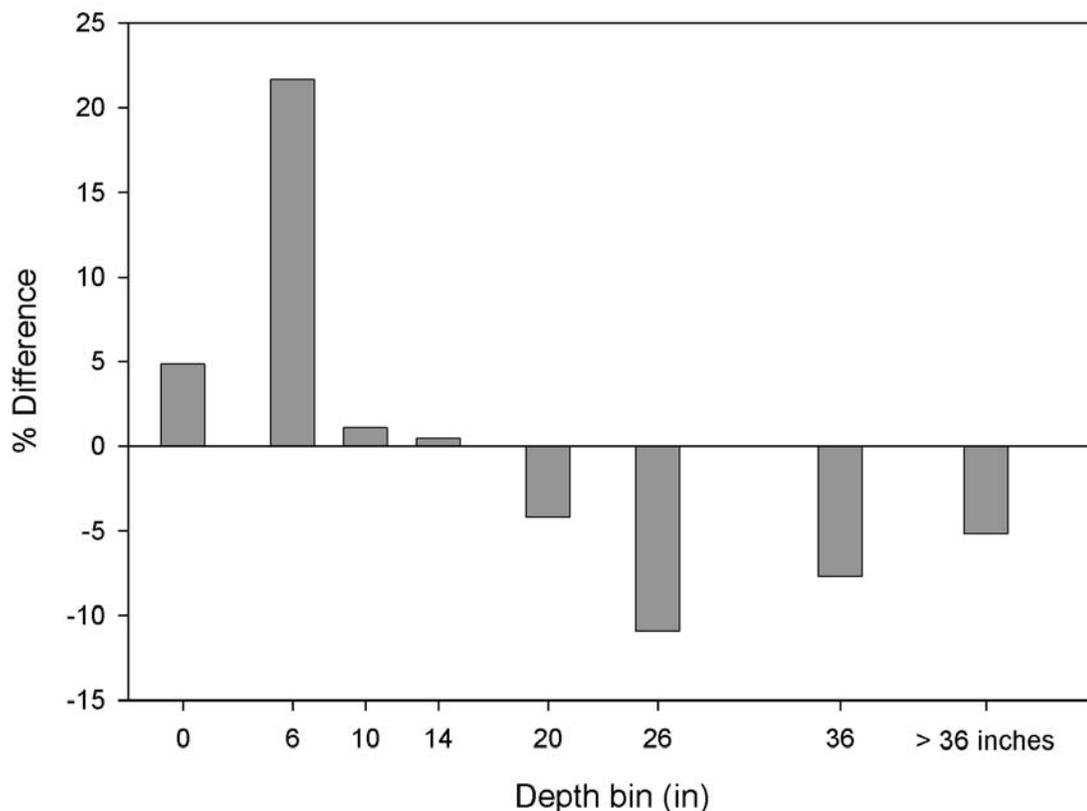


Figure 3. Percent difference in depth categories between Wailuanui Stream, Maui and all streams statewide in DAR Aquatics Surveys Database. Positive values (red) denote an increase in the percent frequency of a depth category in Wailuanui Stream as compared to streams statewide. Negative values (green) denote a decrease in the percent frequency of a depth category in Wailuanui Stream as compared to streams statewide.

Conclusions:

The native animals observed in Wailuanui Stream displayed a depth suitability pattern that ranged from highly unsuitable at dry or shallow sites to highly suitable at deeper sites. This general pattern was followed by all of the native fishes and macroinvertebrates analyzed and thus deeper waters in a stream are more likely important to native stream animals. The general pattern observed in Wailuanui Stream was consistent with depth suitability findings for these species statewide suggesting that the native animals in Wailuanui behave in a fairly typical pattern.

While the animals that exist in Wailuanui Stream display normal depth selectivity, the availability of suitable depths was quite different in Wailuanui Stream than observed in streams statewide. The frequency of sampling a dry or shallow site (6 inches depth or less) went from about 12 in 100 sites statewide to more than 39 in 100 sites in Wailuanui. Deeper sites were also different, with sites 26 inches depth or greater being encountered

27 out of 100 in streams statewide while only 4 out of 100 on Wailuanui Stream. The diversion of water appears to be resulting in a shallower than average stream.

Field surveyors noted that the dry and very shallow sections of the stream were associated with stream diversions and this is supported by images in the photograph section of this report. This stream was not surveyed over a wide range of elevations; therefore it is difficult to assess the amount of habitat influence by the stream diversions. The presence of multiple native species suggests that some suitable habitat exists in this stream.

Return of water into Wailuanui Stream would likely have a beneficial effect on the availability of suitable depths for native species in the currently dewatered or shallow stream sections.

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Section 6: Photographs taken during stream surveys

Estuary:

No estuary on this stream.

Lower Reach:

No lower reach on this stream

Middle Reach:

No photographs available

Upper Reach:



Upstream view from below diversion on West Wailuanui Stream, survey site dk061n-040308. Note trickle of flow (yellow oval) below the diversion



Water collection dam near EMI jeep road on the upper reach of West Wailuanui Stream, Maui,. Survey site dk61n-040308.



Concrete dam across West Wailuanui Stream upstream of collection area, dk061n-040308.



The upper reach of the Wailuanui Stream at the EMI maintenance road. Image taken on 4/3/2008 by Glenn Higashi.



Water collection area at diversion on East Wailuanui Stream at site sh003_040308.



Concrete pond for water collection, same area as last picture at site sh003_040308.



Rock wall dam with metal gate on right on East Wailuanui stream at site sh003_040308.

Headwaters:

No aquatic insect or point quadrat surveys were conducted or photographs taken.