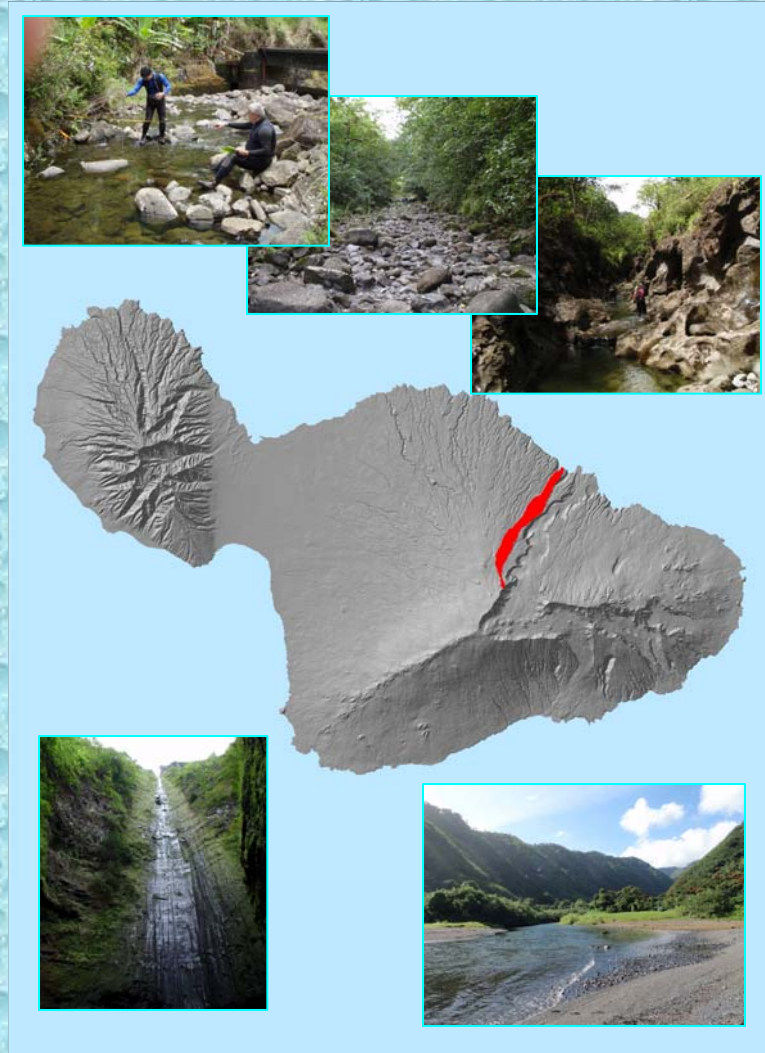


Report on Honomanū Stream Maui, Hawai‘i



August 2009

State of Hawai‘i
Department of Land and Natural Resources
Division of Aquatic Resources
and
Bishop Museum





Funded in part by the Commission on
Water Resource Management, DLNR
and



Funded in part by the U.S. Fish &
Wildlife Service through its State
Wildlife Grant and Wildlife and
Sport Fish Restoration Program.



The Department of Land and Natural Resources receives financial support under the Federal Aid in Fish and Wildlife Restoration and other federal aid programs. Under Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, and the laws of the State of Hawaii, the U.S. Department of the Interior and the State of Hawaii prohibit discrimination on the basis of race, color, religion, sex, national origin or handicap. If you believe that you have been discriminated against in any program, activity or facility, or if you desire further information, please write to the Office of Equal Opportunity, U.S. Department of the Interior, Washington, DC 20240.

Report on Honomanū Stream Maui, Hawai‘i

August 2009

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

Prepared by
Division of Aquatic Resources¹
Department of Land and Natural Resources
State of Hawai‘i
and
Bishop Museum²

Authors:
Glenn Higashi¹, James Parham², Eko Lapp¹, Skippy Hau¹, Darrell
Kuamo‘o¹, Lance Nishiura¹, Tim Shindo¹, Troy Sakihara¹,
Troy Shimoda¹, and Robert Nishimoto¹ and Dan Polhemus¹

Table of Contents

Section 1: Introduction	5
Overview	5
Findings for Honomanū Stream, Maui	6
Discussion	6
Section 2: Watershed Atlas	9
Watershed Features	9
Stream Features	10
Biotic Sampling Effort	10
Biota Information	11
Historic Rankings	13
Current Watershed and Stream Ratings	13
Watershed Rating	14
Biological Rating	16
Overall Rating	17
Rating Strength	17
References	17
Section 3: DAR Point Quadrat Survey Report for Honomanū, Maui	19
Introduction	19
Methods	19
Results	20
Estuary	20
Lower Reach	20
Middle Reach	22
Upper Reach	23
Summary	24
Section 4: DAR Estuary Survey Report for Honomanū Bay, Maui	33
Introduction	33
Materials and Methods	33
Results	34
Summary	36
Section 5: Photographs taken during stream surveys	37
Aerial Photographs	37
Estuary and Lower Reach	39
Estuary	40
Lower reach	43
Middle Reach	45
Upper Reach	48
References	57
Appendix: Survey Sites Latitude and Longitude	59

Section 1: Introduction

Overview

On May 24, 2001, the Native Hawaiian Legal Corporation (NHLC) filed a Petition to Amend the Interim Instream Flow Standard (IIFS) for 27 streams in east Maui on behalf of resident taro farmers. Since the acceptance of the petitions in July 2001, the Commission on Water Resource Management (CWRM) has been focused on gathering information for the 27 petitioned streams. Shortly thereafter, NHLC and CWRM staff reached an agreement that efforts would focus on 8 of the 27 petitioned streams: Honopou, Hanehoi, Huelo, Waiokamilo, Kualani, Pi‘ina‘au, Palauhulu, and Wailua Nui Streams. Currently, the CWRM is collaborating with the State’s Division of Aquatic Resources and the U.S. Geological Survey (USGS) for assistance in collecting biological and hydrologic data to determine measurable interim IFS. CWRM has also requested biological data on the remaining 19 petitioned streams which is the main purpose of this report.

This report is an accounting of the aquatic resources that have been observed in Honomanū Stream, Maui from year 2000 to present. The focus of this report is on the animals and insects that live in the stream and the data collected during surveys. The report covers five main sections, including:

- Introduction
- Watershed Atlas Report
- DAR Point Quadrat Survey Report
- DAR Estuary Survey Report
- Photographs of stream taken during stream surveys

The introduction provides the overview 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/unpublished surveys, including 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 Estuary Survey Report describes the distribution, habitats, and species observed in the estuary during the standardized DAR estuary surveys. 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 conditions of Honomanū Stream while also providing substantial evidence to support the conclusions presented.

Findings for Honomanū Stream, Maui:

Honomanū is a small (5.4 sq miles) watershed with steep upper sections and little embayment. It is fully zoned for conservation (100%) and the land cover is mostly evergreen forest (74%), scrub (22%) and grassland (4%). Numerous stream surveys of different types have been completed in Honomanū stream beginning in 1929 to the present. This watershed rates high in comparison to other watersheds in Maui and statewide, based on data in the DAR aquatic surveys database. It has a total watershed rating of 8 out of 10, a total biological rating of 7 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 xenura*, *Lentipes concolor* and *Mugil cephalus*

Crustaceans - *Atyoida bisulcata*

Insect – *Anax junius*, *Anax* sp., *Megalagrion hawaiiense*, *Megalagrion* sp. and *Telmatogen* sp.

Snails – *Neritina vespertina* and *Neritina granosa*

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

Crustaceans - *Macrobrachium lar*

Fish - *Xiphophorus helleri*

Insects - Chironomid sp.

Snails - Physid sp.

Discussion

Honomanū watershed is small, steep in the upper watershed, and with little embayment at the mouth. Aerial photographs show a wide stream mouth with a wide flat lower reach. The stream mouth was open with minimal flow, with an estuary that was considerably larger than most of the other estuaries surveyed in East Maui. The bay size and formation provide calm water and allow for a greater tidal influence with the tidal wedge moving further inland. Moving from the lower reach further inland to the middle reach, the valley walls close in on the stream channel and become steeper.

Access to the stream mouth, lower reach and middle reaches is possible by vehicle and foot as the Hāna Highway comes close the coastline. The upper reaches were accessed by helicopter as the steepness increased with elevation with high waterfalls. Although the stream channel narrowed in the upper reach, it did widen out again at higher elevations.

An older estuary survey methodology was used when sampling was conducted in Honomanū estuary, which is slightly different than the newer methodology that was used in other estuaries in East Maui. Cast net sampling resulted in numerous catches of **āholehole** (*Kuhlia xenura*), **‘iao** (*Atherinomorus insularum*), **Kanda mullet** (*Valamugil engeli*) and **‘ama‘ama** (*Mugil cephalus*). Also observed around the stream mouth were juvenile **hapawai** (*Neritina vespertina*), **hīhīwai** (*Neritina granosa*), **‘o‘opu ‘akupa** (*Eleotris sandwicensis*), and **‘o‘opu nākea** (*Awaous guamensis*).

Point quadrat surveys were conducted in the lower, middle and upper reaches of Honomanū Stream. Surveys started at the stream mouth to the first major waterfall in the middle reach. The

majority of survey sites in the lower and middle reach had no water, providing minimal habitat. Water in the lower reach near the stream mouth was fed through underground springs that provided suitable habitat for native and endemic species such as *K. xenura*, *M. cephalus*, *N. vespertina* and *N. granosa*. A single river prawn (*Macrobrachium grandimanus*) was recorded in a plunge pool with no flow at the base of the first major waterfall in the middle reach. *A. bisulcata* were observed in the upper reach below and above the diversions where flow was greater than in the lower reach. Adult ‘o‘opu ‘alamo‘o (*Lentipes concolor*) were also observed in a plunge pool at the base of a trickling waterfall in the upper reach below the diversions. A maximum of 1.53 cfs was recorded in the upper reach above the diversions, compared to 0.41 cfs recorded in the lower reach below the diversions.

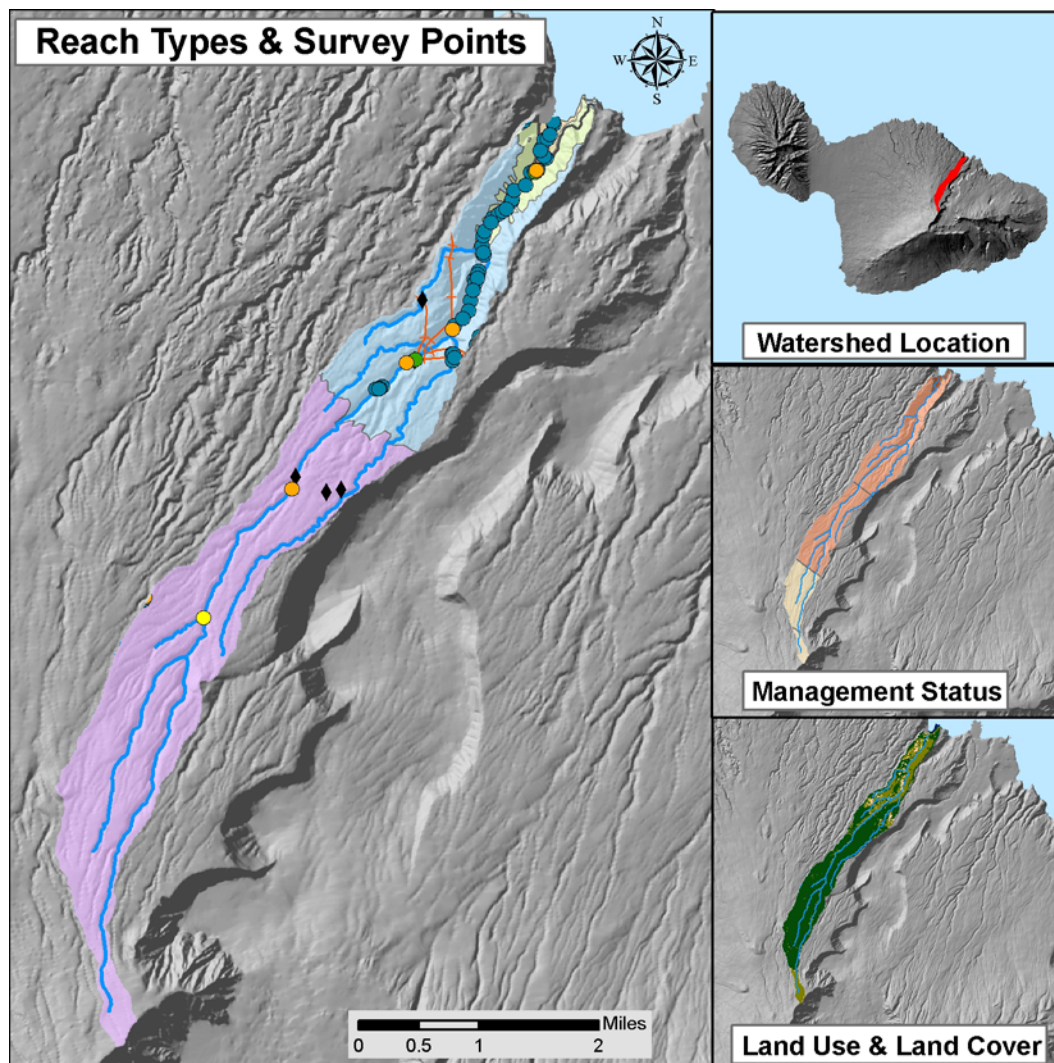
Honomanū Stream has very limited instream habitat that is available to stream animals. This is the result of reduced stream flow caused by diversions in the upper reach. Nonetheless, a few native species were still observed in what little habitat that was available. Therefore, restoration of flow downstream would provide more habitats for a range of native species downstream of the diversion. Improvement for fish passage for both up and down stream migration could also substantially increase accessibility to available habitat for *L. concolor* and *A. bisulcata* and would further enhance the overall productivity of Honomanū Stream.

Blank Page

Section 2: Watershed Atlas

DAR Watershed Code: 64009

Honomanū, Maui



WATERSHED FEATURES

Honomanū watershed occurs on the island of Maui. The Hawaiian meaning of the name is unknown. The area of the watershed is 5.4 square mi (14 square km), with maximum elevation of 8314 ft (2534 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: 0% agricultural, 100% 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	3.2	76.9	0.0	0.0	18.1	1.8

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>
21.3	76.9	0.0	1.8

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	0.1	0.00	0.01
Cultivated	0.0	0.00	0.00
Grassland	3.9	0.21	0.54
Scrub/Shrub	22.0	1.19	3.08
Evergreen Forest	73.7	3.99	10.34
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	0.1	0.01	0.02
Unconsolidated Shoreline	0.0	0.00	0.00
Water	0.2	0.01	0.03
Unclassified	0.0	0.00	0.00

STREAM FEATURES

Honomanū is a perennial stream. Total stream length is 18.4 mi (29.7 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	3.9	4.3	32.5	59.3

The following stream(s) occur in the watershed:
Honomanū

BIOTIC SAMPLING EFFORT

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

1929 1963 2003 2008 2009

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>
Damselfly Surveys	0	0	0	0	1
DAR Point Quadrat	1	16	15	23	0
HDFG	0	1	0	2	1
Published Report	0	1	0	1	0

BIOTA INFORMATION

Species List

Native Species

Crustaceans *Atyoida bisulcata*
Fish *Awaous guamensis*
Eleotris sandwicensis
Kuhlia xenura
Lentipes concolor
Mugil cephalus

Native Species

Insects *Anax junius*
Anax sp.
Megalagrion hawaiiense
Megalagrion sp.
Telmatogeton sp.
Snails *Neritina granosa*
Neritina vespertina

Introduced Species

Crustaceans *Macrobrachium lar*
Fish *Xiphophorus helleri*

Introduced Species

Insects Chironomid sp.
Snails Physid sp.

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	0.75	2	1.3
<i>Macrobrachium lar</i>	Introduced	1.25	5.5	3.3
<i>Eleotris sandwicensis</i>	Endemic	5	5	5.0
<i>Kuhlia xenura</i>	Endemic	2	3	2.3
<i>Lentipes concolor</i>	Endemic	2	3.5	3.0
<i>Awaous guamensis</i>	Indigenous	1.25	6	3.1
<i>Mugil cephalus</i>	Indigenous	4.5	4.5	4.5
<i>Xiphophorus helleri</i>	Introduced	3.5	5	4.3
<i>Neritina granosa</i>	Endemic	1	1.25	1.2
<i>Neritina vespertina</i>	Endemic	0.5	1.25	1.0
Physid sp.	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>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
<i>Atyoida bisulcata</i>	Endemic				0.29	
<i>Kuhlia xenura</i>	Endemic		0.38			
<i>Lentipes concolor</i>	Endemic				0.37	
<i>Neritina granosa</i>	Endemic		0.28	0.15		
<i>Neritina vespertina</i>	Endemic		0.47			
<i>Awaous guamensis</i>	Indigenous		0.09	0.08		
<i>Mugil cephalus</i>	Indigenous		0.09			
<i>Macrobrachium lar</i>	Introduced			0.23	0.51	
Physid sp.	Introduced				1.17	
<i>Xiphophorus helleri</i>	Introduced		0.38			

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>Eleotris sandwicensis</i>	Endemic		P			
<i>Kuhlia xenura</i>	Endemic		P			
<i>Lentipes concolor</i>	Endemic			P	P	
<i>Megalagrion hawaiiense</i>	Endemic					P
<i>Megalagrion</i> sp.	Endemic		P		P	P
<i>Neritina granosa</i>	Endemic		P	P		
<i>Neritina vespertina</i>	Endemic		P			
<i>Awaous guamensis</i>	Indigenous		P	P		
<i>Mugil cephalus</i>	Indigenous		P			
<i>Anax junius</i>	Indigenous					P
<i>Anax</i> sp.	Indigenous				P	
<i>Telmatogeton</i> sp.	Indigenous				P	
<i>Macrobrachium lar</i>	Introduced		P	P	P	
<i>Xiphophorus helleri</i>	Introduced		P			
Chironomid sp.	Introduced		P			
Physid sp.	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): Limited

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

The Nature Conservancy- Priority Aquatic Sites (1985): Yes

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.

No

Native Macrofauna
Diversity > 5 spp.

Yes

Absence of Priority 1
Introduced

No

Abundance of Any
Native Species

No

Presence of Candidate
Endangered Species

No

Endangered Newcomb's
Snail Habitat

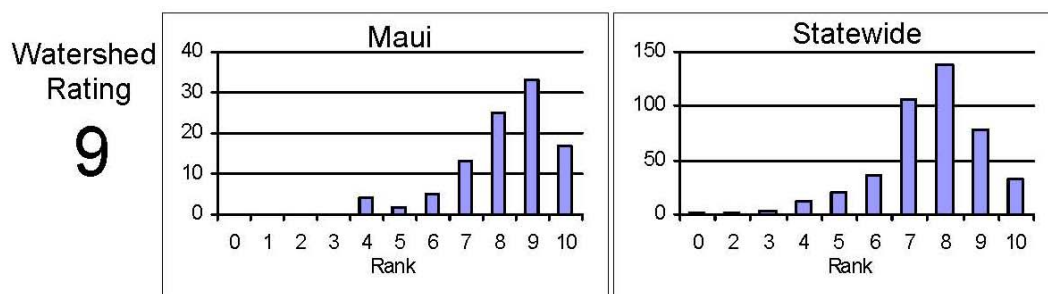
No

CURRENT WATERSHED AND STREAM RATINGS

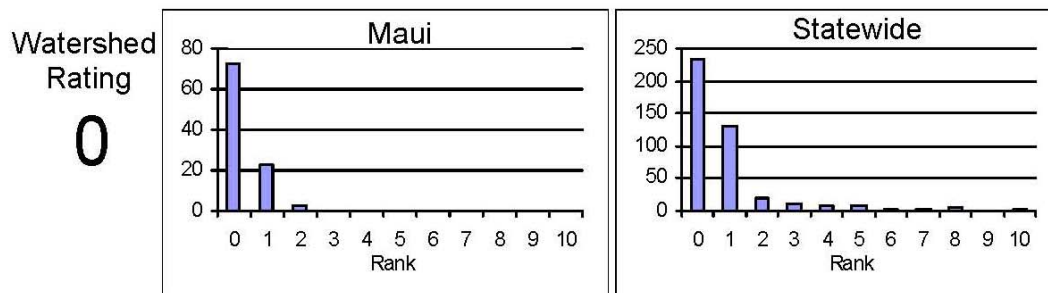
The current watershed and stream ratings are based on the data contained in the DAR Aquatic Surveys Database. The ratings provide the score for the individual watershed or stream, the distribution of ratings for that island, and the distribution of ratings statewide. This allows a better understanding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

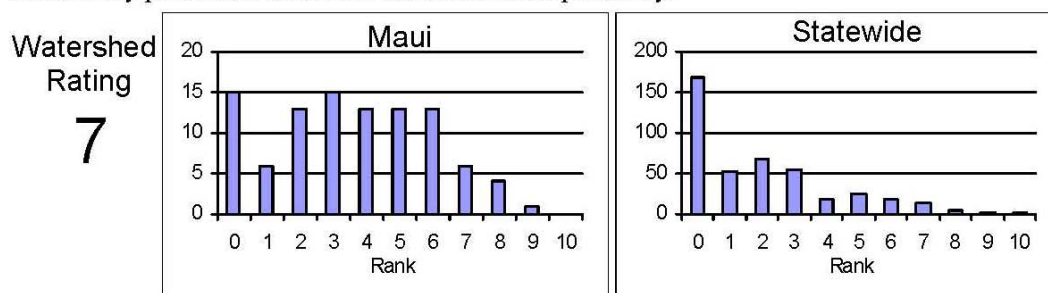
Land Cover Rating: Rating is based on a scoring system where in general forested lands score positively and developed lands score negatively.



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

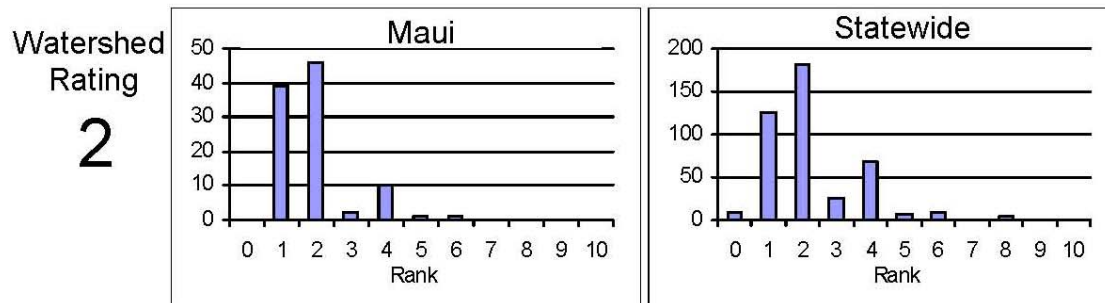


Stewardship Rating: Rating is based on a scoring system where higher levels of land and biodiversity protection within the watershed score positively.

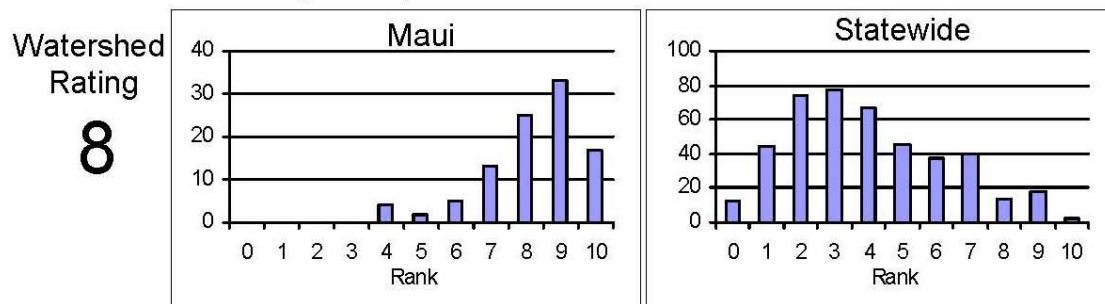


WATERSHED RATING (Cont): Honomanū, Maui

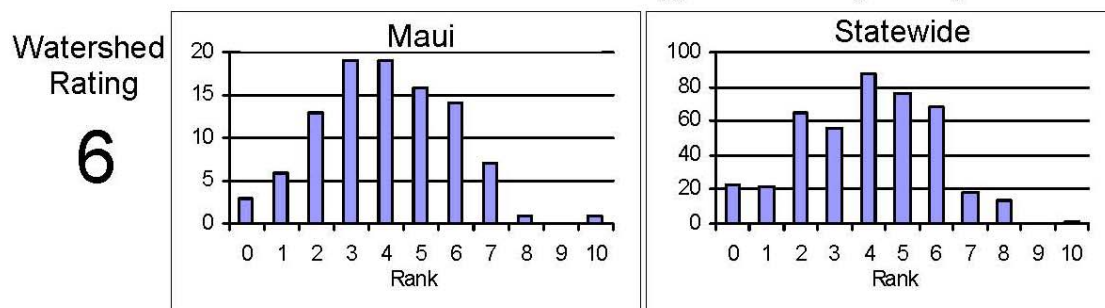
Size Rating: Rating is based on the watershed area and total stream length. Larger watersheds and streams score more positively.



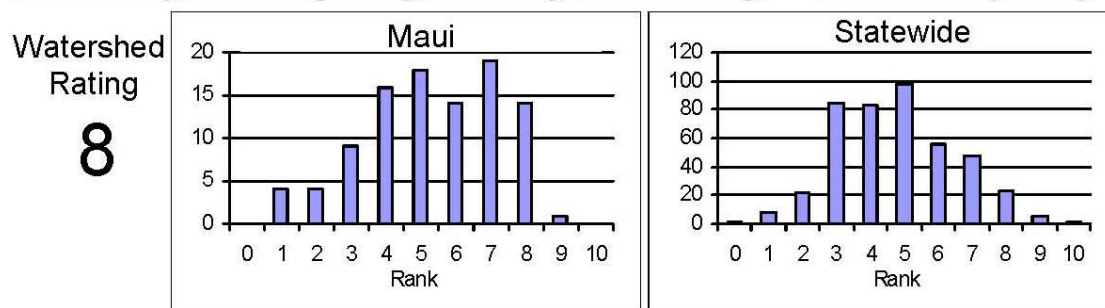
Wetness Rating: Rating is based on the average annual rainfall within the watershed. Higher rainfall totals score more positively.



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.



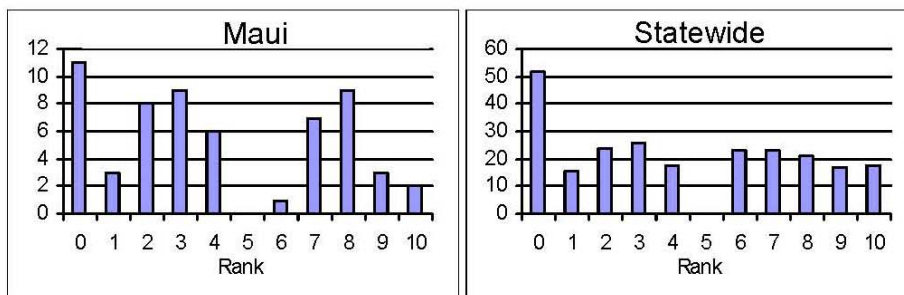
Total Watershed Rating: Rating is based on combination of Land Cover Rating, Shallow Waters Rating, Stewardship Rating, Size Rating, Wetness Rating, and Reach Diversity Rating.



BIOLOGICAL RATING: Honomanū, Maui

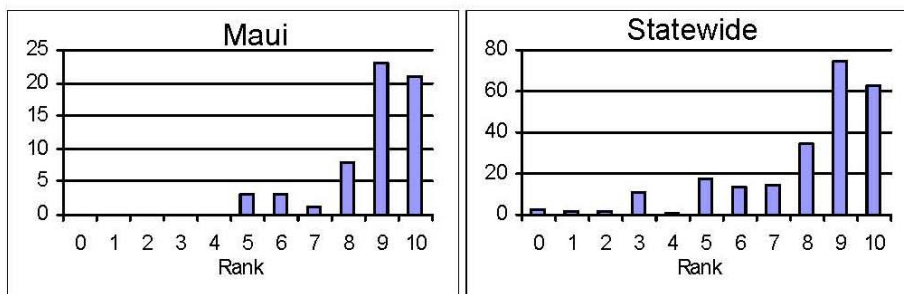
Native Species Rating: Rating is based on the number of native species observed in the watershed.

Stream
Rating
7



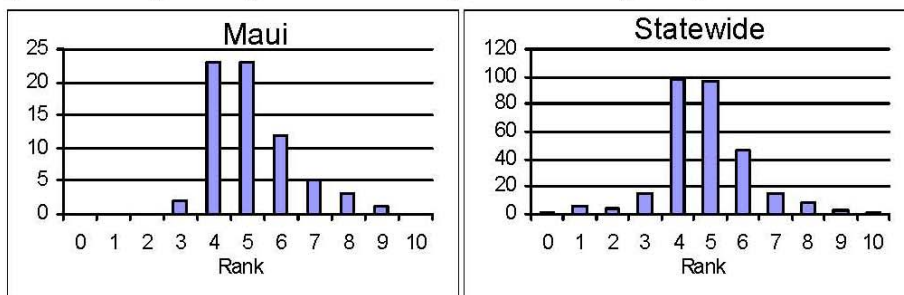
Introduced Genera Rating: Rating is based on the number of introduced genera observed in the watershed.

Stream
Rating
9



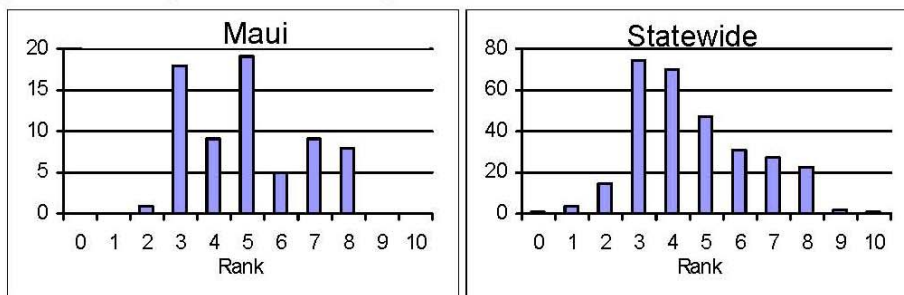
All Species' Score Rating: Rating is based on the Hawaii Stream Assessment scoring system where native species score positively and introduced species score negatively.

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
7

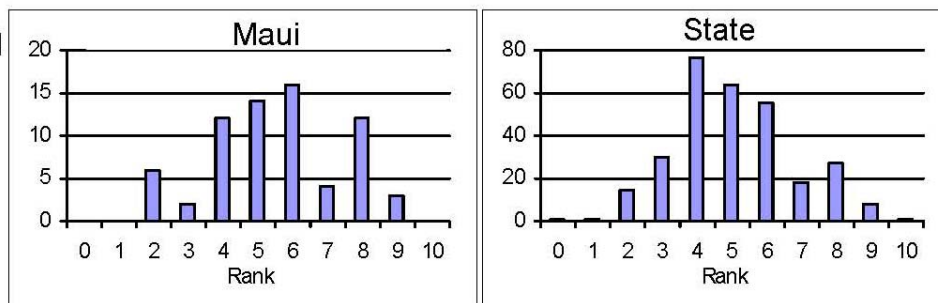


OVERALL RATING: Honomanū, Maui

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

Watershed
Rating

8

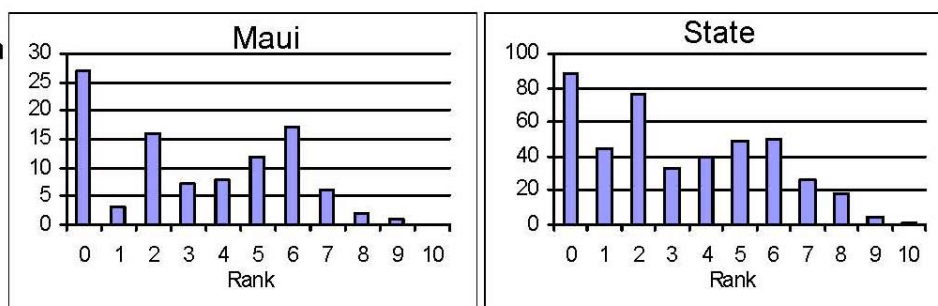


RATING STRENGTH: Honomanū, Maui

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.

Information
Rating

6



REFERENCES

- 1963. Shima, S.I. Limnological Survey for Introduction of Exotic Species of Fish.
- 2005. Gingerich, S.B. and R.H. Wolff. Effects of Surface-Water Diversions on Habitat Availability for Native Macrofauna, Northeast Maui, Hawai'i.
- 2006. Polhemus, D.A. Megalagrion Survey Notes in spreadsheet form.
- 2008. Hawai'i Division of Aquatic Resources. DAR Point Quadrat Survey Data from the DAR Aquatic Surveys Database.

Blank Page

Section 3: DAR Point Quadrat Survey Report for Honomanū, Maui

For Surveys from 12/8/2008 to 6/30/2009

Introduction

This is a report of the Hawai'i Division of Aquatic Resources stream surveys using the Point Quadrat Methodology. Trained biologists and technicians survey a series of randomly located points in a stream to generate an assessment of the species and habitat in the stream. The Point Quadrat Methodology is one of several techniques that could be chosen for the surveys and is used to develop a statistically comparable stream survey. This methodology is a standardized visual survey technique involving snorkeling, and it is well suited for the physical and ecological characteristics of Hawai'i streams. The small, steep, dynamic nature of Hawaiian streams with their unique aquatic species is easily observed with this methodology. The in-stream distribution by elevation, behavior, and amphidromous life cycles are easily observed using this technique.

Methods

The point quadrat methodology requires underwater observation. Sampling was conducted using a dive mask, snorkel and two-piece wet suit with hood and glove. Spiked felt-soled wading boots or Japanese spiked **tabis** are also necessary for easy climbing on the wet, algae-covered rocks. After the initial survey site is chosen all the survey sites upstream are selected randomly to prevent any bias in habitat type selection (e.g., pools and runs) and to obtain a representative sample of all habitat types in the stream. At each site, fish and invertebrate observations are recorded and data is collected on the species present, number, size, and sex. Habitat and substrate type, depth and site dimension data are also collected. Other site observations recorded at each station include GPS coordinates and the following water quality parameters using a Hydrolab Quanta: temperature (° C), salinity (PSS), dissolved oxygen (mg/L), pH, conductivity (mS/cm) and turbidity (NTU). Stream flow measurements are collected using a Marsh McBirney Flo-Mate 2000 at the beginning and ending of each survey as well as at tributaries and diversions.

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

Honomanū (ID: 64009), Ke'anae, Maui

Surveys were conducted by these personnel:

Hau, Skippy
Kuamo'o, Darrell
Nishiura, Lance
Sakihara, Troy
Shimoda, Troy
Shindo, Tim

Results

Table 3-1. The distribution of sites by reach during this survey effort.

Reach	Total number of surveys
Estuary	1
Lower	16
Middle	15
Upper	23
Headwaters	0
Unknown	0

Estuary

Table 3-2. Number of Habitat Types surveyed in the estuary.

Reach	Total Habitats Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
Estuary	1	0	0	0	0	0	0	0	1	0

Table 3-3. Observed Substrates (%) in point quadrat samples in the estuary.

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
Estuary	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 3-4. Observed Water Quality in point quadrat samples in the estuary.

Reach	Temp (° C)	sCond (mS/cm)	DO (mg/L)	pH	Turbidity (NTU)
Estuary	21.29	17.6	7.52	7.35	n/a

Lower Reach

Table 3-5. Number of Habitat Types surveyed in the lower stream reach.

Reach	Total Habitats Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
Lower	13	0	0	1	2	2	1	7	0	0

Table 3-6. Observed Substrates (%) in point quadrat samples in the lower stream reach.

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
Lower	7	0	2	15	23	45	8

Table 3-7. Observed Water Quality in point quadrat samples in the lower stream reach.

Reach	Temp (° C)	sCond (mS/cm)	DO (mg/L)	pH	Turbidity (NTU)
Lower	20.827	1.77	6.714	7.783	6

Table 3-8. Summary of species observed in the lower reach of the watershed.

Category	Status	Scientific Name
Crustacean	Introduced	<i>Macrobrachium lar</i>
Fish	Introduced	<i>Xiphophorus helleri</i>
Fish	Endemic	<i>Eleotris sandwicensis</i>
Fish	Endemic	<i>Kuhlia xenura</i>
Fish	Indigenous	<i>Mugil cephalus</i>
Fish	Indigenous	<i>Awaous guamensis</i>
Snail	Endemic	<i>Neritina granosa</i>
Snail	Endemic	<i>Neritina vespertina</i>

Table 3-9. Average Density and Total number of animals observed in the lower stream reach.

Density values are calculated only for random sites, not non-random or outside sites, greater than 6 by 6 inches. Density values are in number of animals per square yard.

Category	Status	Scientific Name	Reach	Avg. Density	Total # observed
Fish	Indigenous	<i>Mugil cephalus</i>	Lower	0.09	1
Fish	Endemic	<i>Kuhlia xenura</i>	Lower	0.38	4
Snails	Endemic	<i>Neritina vespertina</i>	Lower	0.47	5
Snails	Endemic	<i>Neritina granosa</i>	Lower	0.28	3

Middle Reach

Table 3-10. Number of Habitat Types surveyed in the middle stream reach.

Reach	Total Habitats Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
Middle	14	1	0	0	0	0	1	12	0	0

Table 3-11. Observed Substrates (%) in point quadrat samples in the middle stream reach.

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
Middle	2	0	1	12	13	65	7

Table 3-12. Observed Water Quality in point quadrat samples in the middle stream reach.

Reach	Temp (° C)	sCond (mS/cm)	DO (mg/L)	pH	Turbidity (NTU)
Middle	19.47	0.055	6.993	8.023	n/a

Table 3-13. Summary of species observed in the middle reach of the watershed.

Category	Status	Scientific Name
Crustacean	Introduced	<i>Macrobrachium lar</i>
Fish	Endemic	<i>Lentipes concolor</i>
Fish	Indigenous	<i>Awaous guamensis</i>
Snail	Endemic	<i>Neritina granosa</i>

Table 3-14. Average Density and Total number of animals observed in the middle stream reach. Density values are calculated only for random sites, not non-random or outside sites, greater than 6 by 6 inches. Density values are in number of animals per square yard.

Category	Status	Scientific Name	Reach	Avg. Density	Total # observed
Crustaceans	Introduced	<i>Macrobrachium lar</i>	Middle	0.08	1

Upper Reach

Table 3-15. Number of Habitat Types surveyed in the upper stream reach.

Reach	Total Habitats Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
Upper	19	1	0	2	2	4	3	7	0	0

Table 3-16. Observed Substrates (%) in point quadrat samples in the upper stream reach.

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
Upper	2	0	0	6	15	50	27

Table 3-17. Observed Water Quality in point quadrat samples in the upper stream reach.

Reach	Temp (° C)	sCond (mS/cm)	DO (mg/L)	pH	Turbidity (NTU)
Upper	21.533	0.08	7.443	7.521	23.985

Table 3-18. Summary of species observed in the upper reach of the watershed.

Category	Status	Scientific Name
Crustacean	Endemic	<i>Atyoida bisulcata</i>
Crustacean	Introduced	<i>Macrobrachium lar</i>
Fish	Endemic	<i>Lentipes concolor</i>
Snail	Introduced	Physid sp.

Table 3-19. Average Density and Total number of animals observed in the upper stream reach. Density values are calculated only for random sites, not non-random or outside sites, greater than 6 by 6 inches. Density values are in number of animals per square yard.

Category	Status	Scientific Name	Reach	Avg. Density	Total # observed
Crustaceans	Introduced	<i>Macrobrachium lar</i>	Upper	0.07	1
Crustaceans	Endemic	<i>Atyoida bisulcata</i>	Upper	1.35	19
Snails	Introduced	Physid sp.	Upper	1.14	16

Table 3-20. Flow data taken during point quadrat in the lower stream reach.

Latitude	Longitude	Total CFS	MGD
20.85843	-156.16835	0.41	0.27

Table 3-21. Flow data taken during point quadrat in the upper stream reach.

Latitude	Longitude	Total CFS	MGD
20.82894	-156.18977	1.53	0.99
20.83271	-156.18056	1.13	0.73
20.83188	-156.18060	1.31	0.95
20.84272	-156.17705	0.01	0

Table 3-22. Locations of the diversions found within the upper reach and it's corresponding tributary.

Latitude	Longitude	Tributary
20.83271	-156.18056	64009004

Summary

Surveys were conducted in Honomanū Stream on 8 and 9 December 2008, and 28 and 30 June 2009. A total of 3275 m of stream length was surveyed in five discrete sections (1,200 m, 1000 m, 800 m, 150 m, 125 m). Water flow data was collected at 5 sites and 1 diversion was observed within a survey area in the upper reach.

Animal Species observed in Honomanū Stream on 8 and 9 December 2008, and 28 and 30 June 2009 surveys.

<u>Category</u>	<u>Status</u>	<u>Scientific Name</u>
Crustacean	Introduced	<i>Macrobrachium lar</i>
Crustacean	Endemic	<i>Atyoida bisulcata</i>
Fish	Endemic	<i>Lentipes concolor</i>
Snail	Introduced	Physid sp.

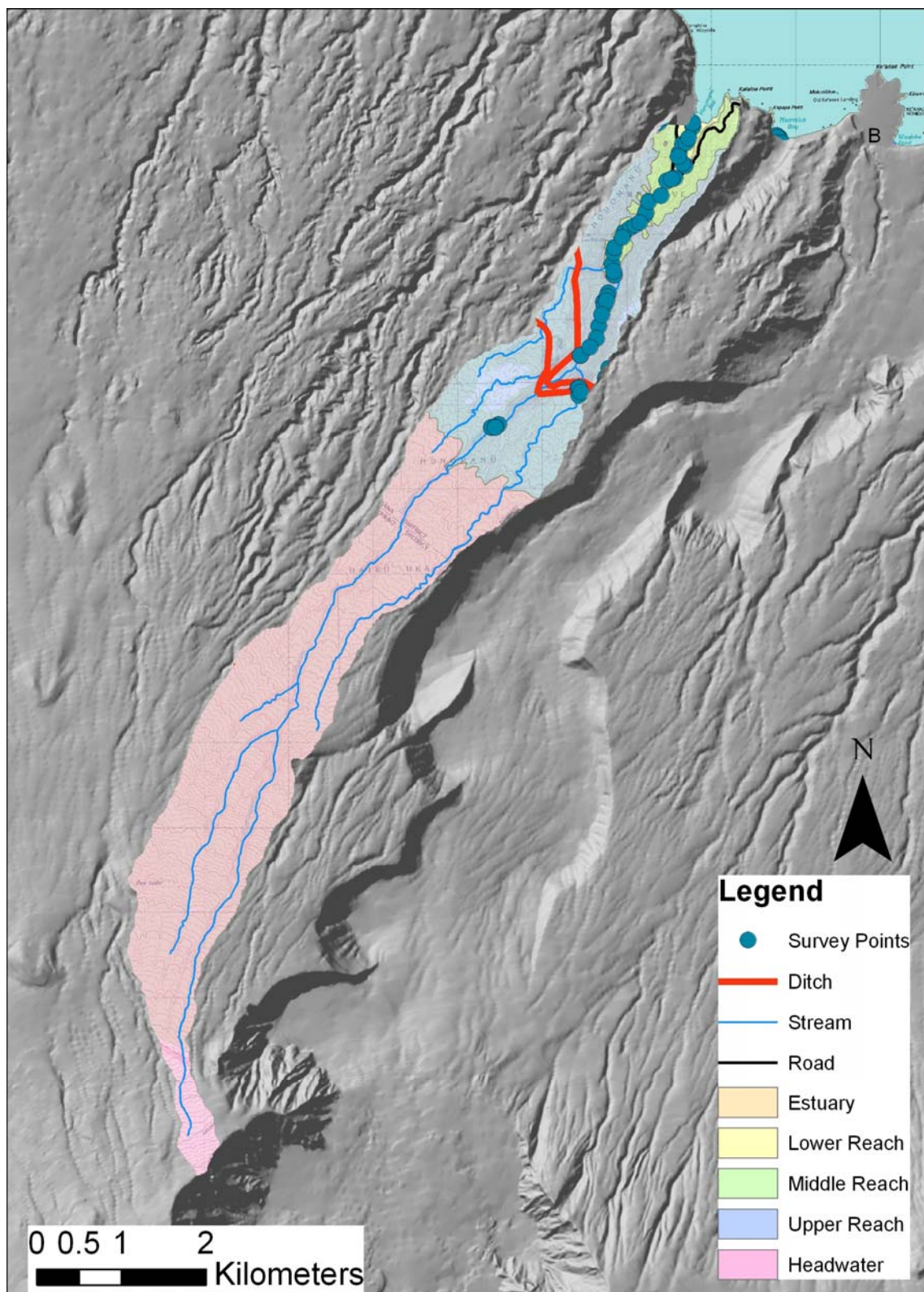


Figure 3-1. Location of point-quadrat surveys conducted in Honomanū Stream.

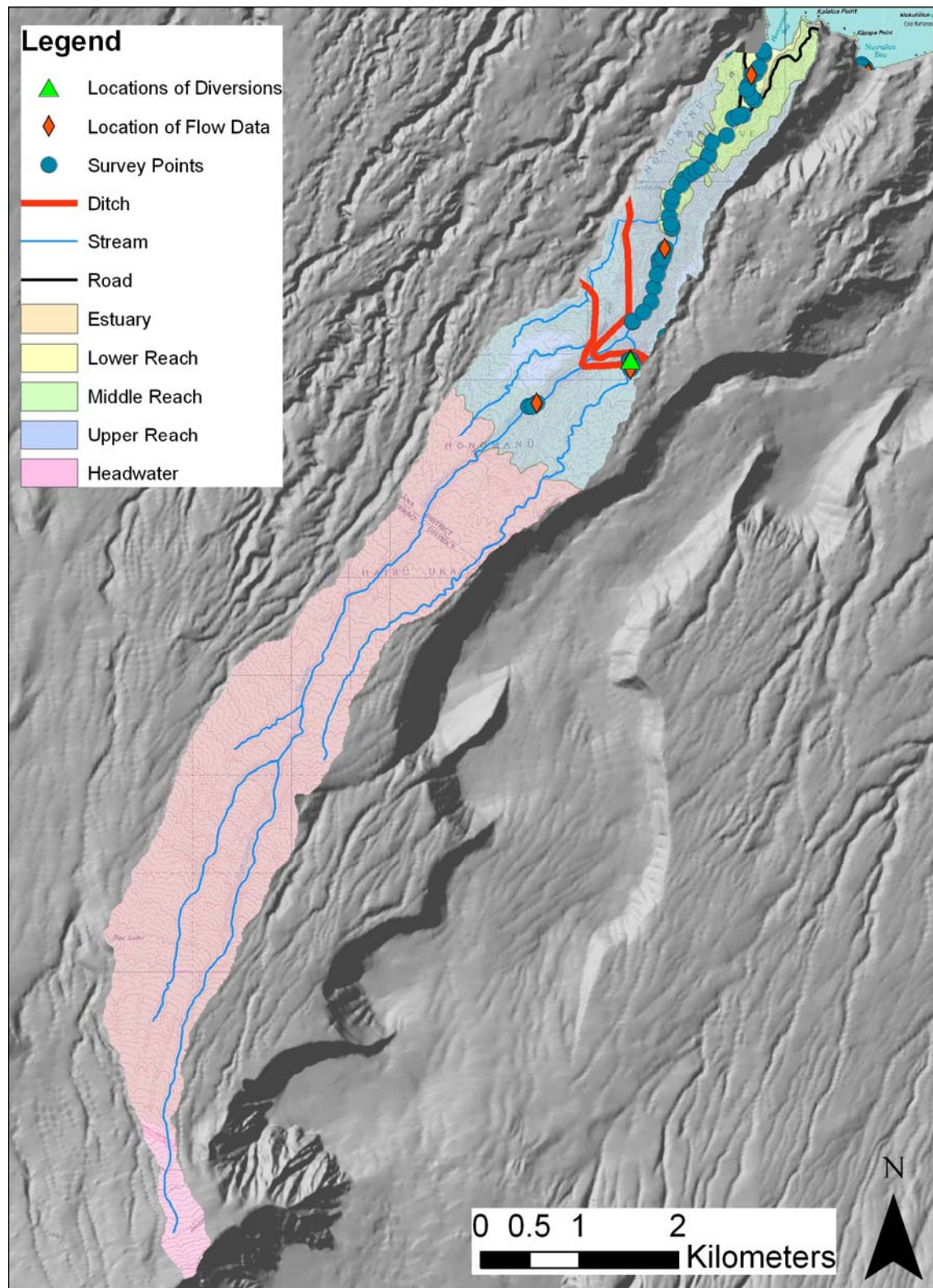


Figure 3-2. Locations of diversion surveys and flow surveys conducted in Honomanū Stream.

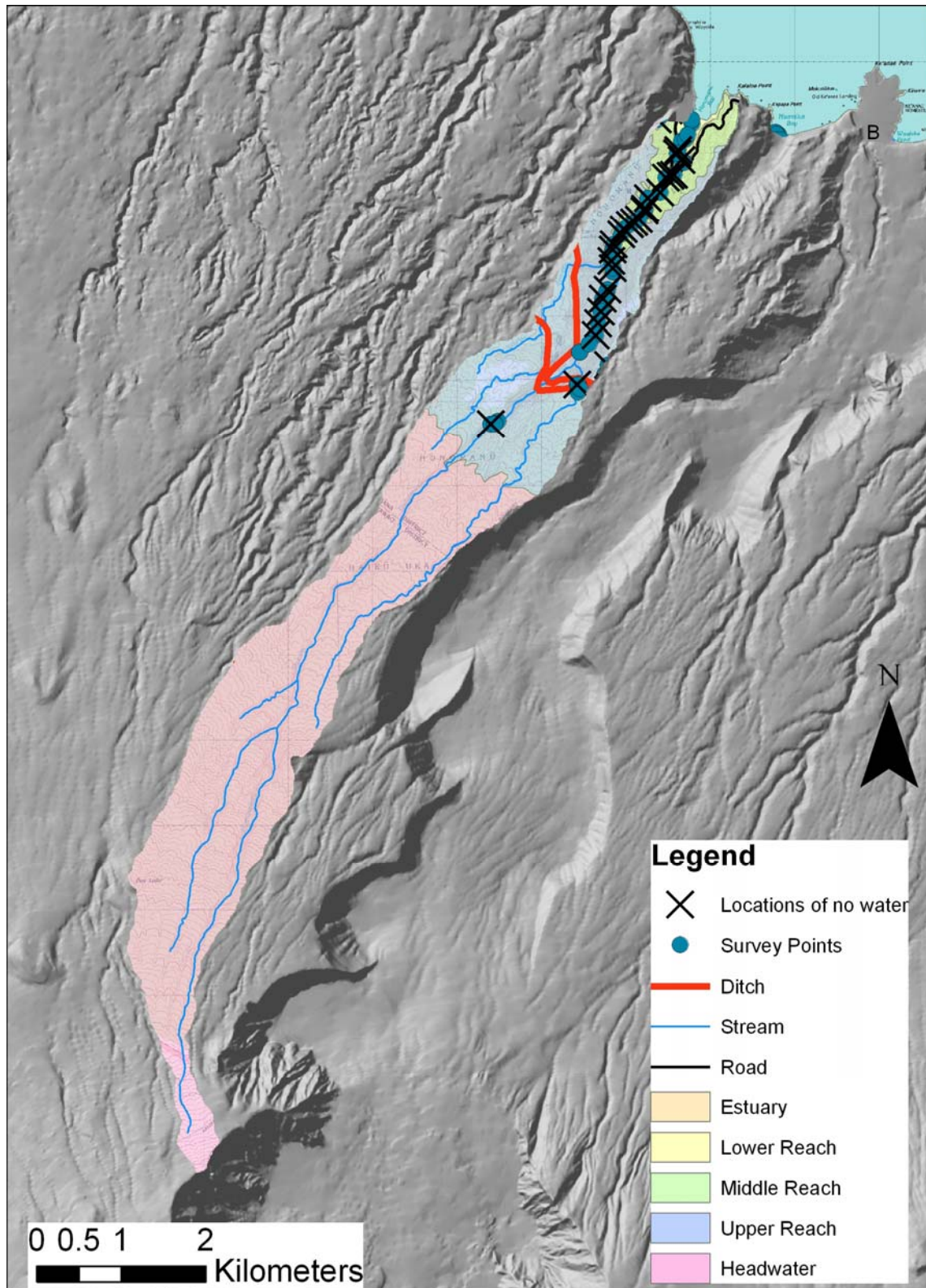


Figure 3-3. Locations of no water conditions in Honomanū Stream.

Lower Reach

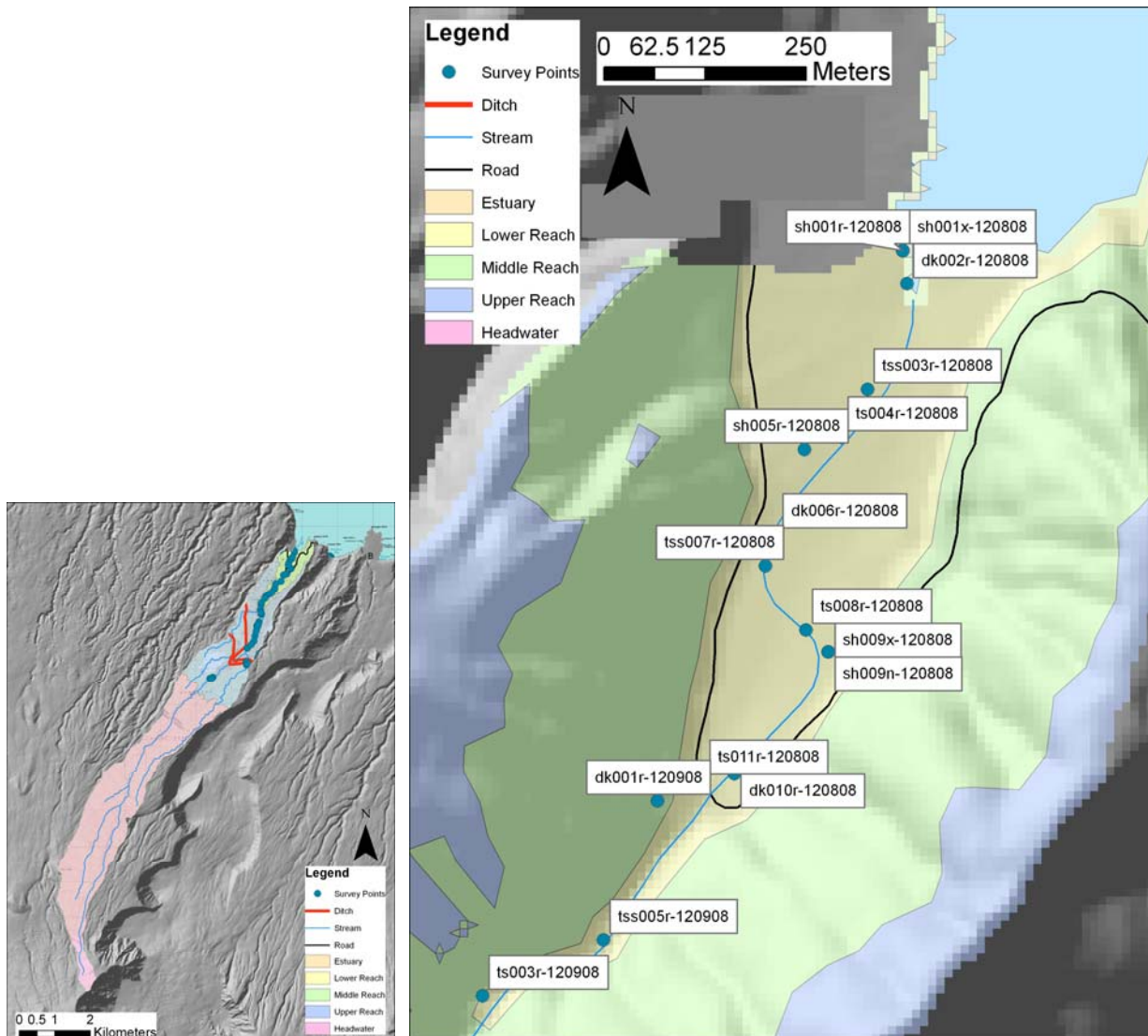


Figure 3-4. Point-quadrat survey locations in the lower reach of Honomanū Stream.

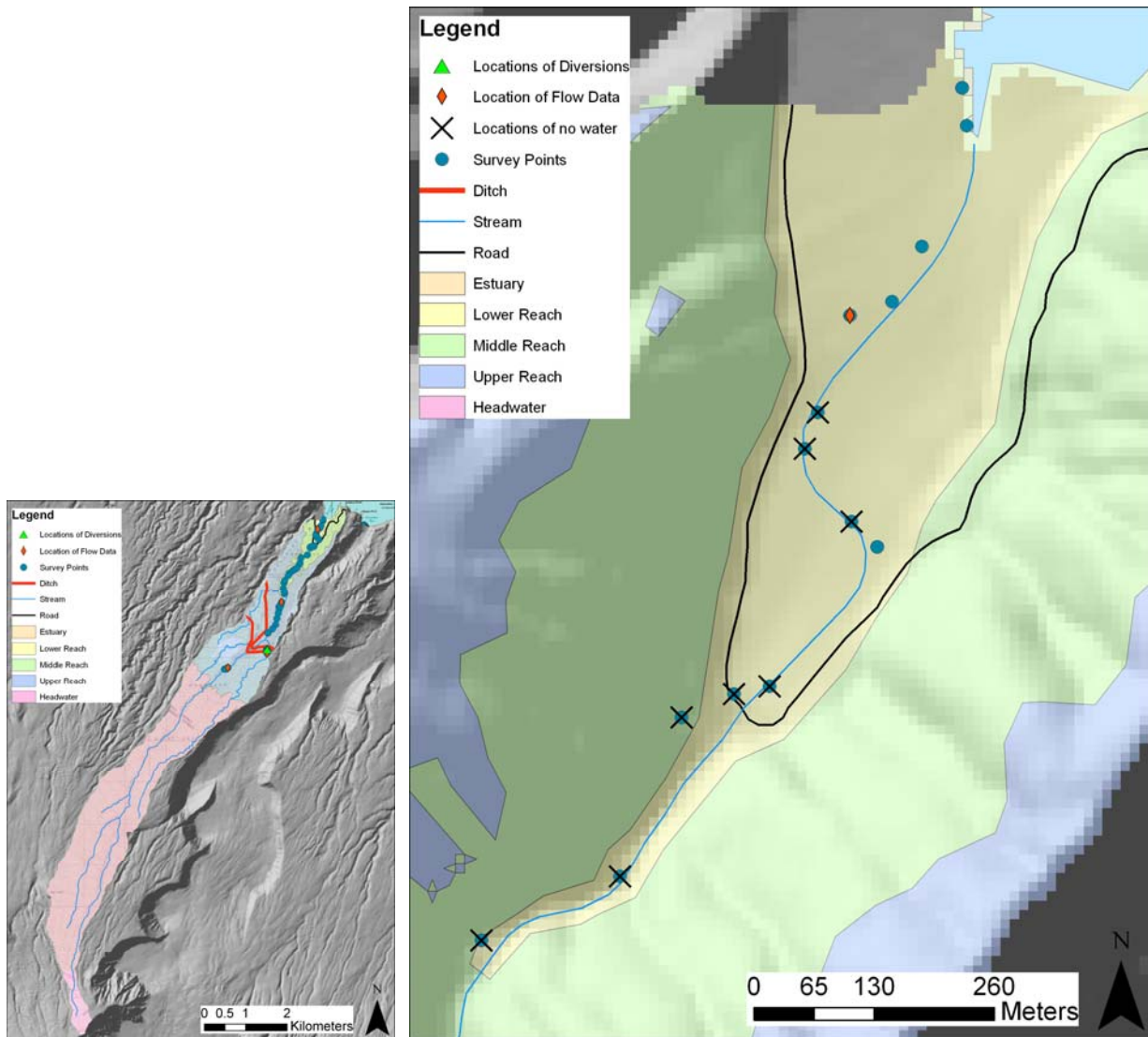


Figure 3-5. Locations of diversion surveys, flow measurement surveys and no water conditions found in the lower reach of Honomanū Stream.

Middle Reach

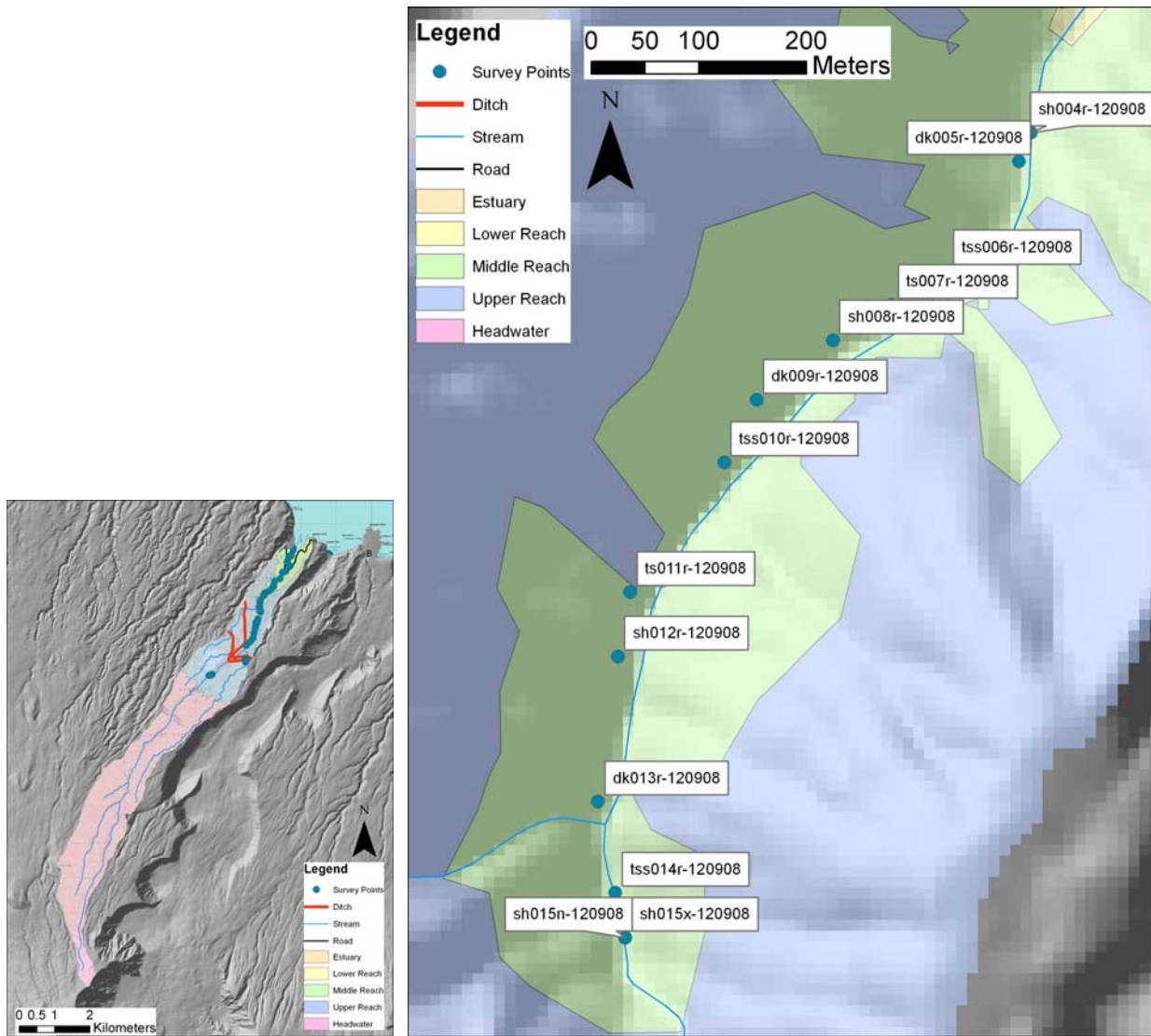


Figure 3-6. Point-quadrat survey locations in the middle reach of Honomanū Stream.

Upper Reach

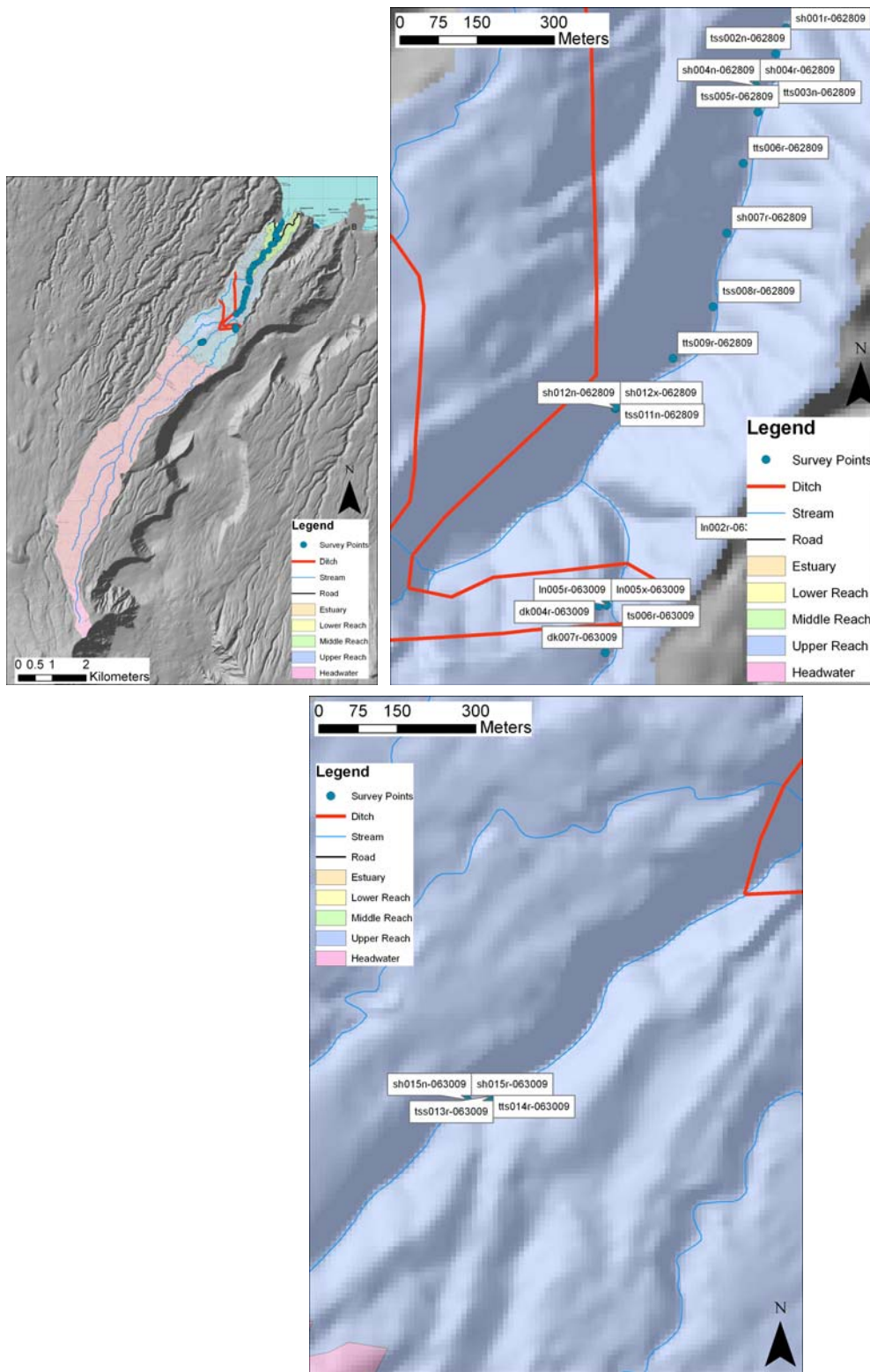


Figure 3-7. Point-quadrat survey locations in the upper reach of Honomanū Stream.

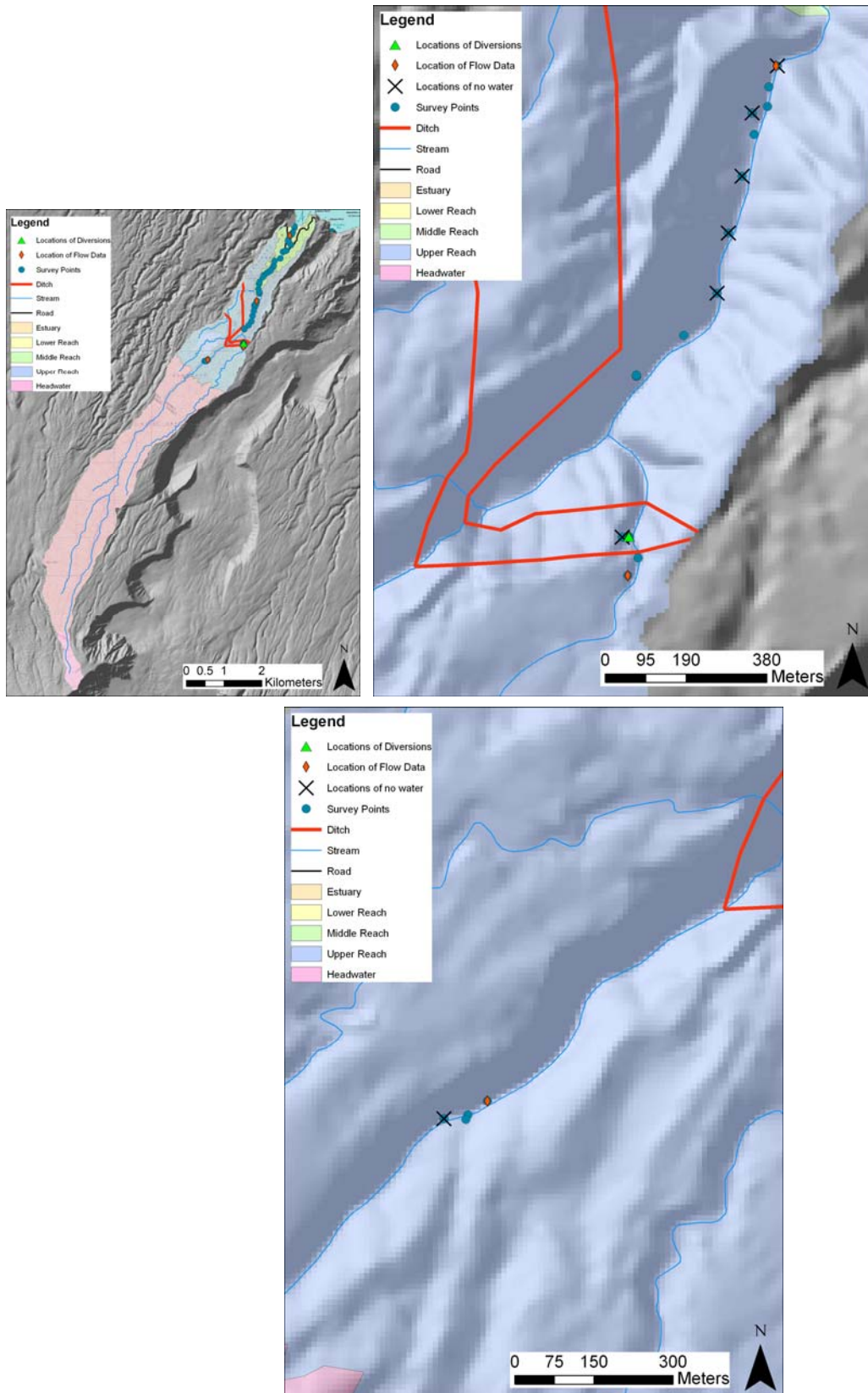


Figure 3-8. Locations of diversions, flow measurements and no water conditions found in the upper reach of Honomanū Stream.

Section 4: DAR Estuary Survey Report for Honomanū Bay, Maui

For Surveys Conducted on: 12/08/2008

Introduction

This is a report of the Hawaii Division of Aquatic Resources estuary survey conducted in Honomanū Watershed, Maui. The main focus of the survey was to document physical conditions and animal species present in the estuary. Trained biologists and technicians sampled a series of randomly located points in the estuary to generate an assessment of species, habitat, and ecological connectivity to stream and coastal habitats. The estuary survey was conducted in conjunction with DAR point-quadrat stream surveys conducted in Honomanū Stream to investigate the effect of stream conditions on the native biota in the stream and estuarine habitat of Honomanū watershed. The data in this report reveals the potential adverse effects of stream alterations to biological resources in the stream and estuary, which bears significant ecological and cultural value. It also provides further information to determine instream flow standards and overall management of streams in Honomanū watershed.

Materials and Methods

Honomanū Bay was divided into 3 sampling stations. Sampling was conducted using two 8 ft length cast nets of two mesh sizes - 3/8 in and 1/4 in. Five random/blind casts of each net were taken at each station within a time limit of 20 minutes per station. Fish and invertebrates captured with each net were separated, measured and recorded according to mesh size. All species captured were identified, measured and recorded in millimeters. Fish were measured by fork-length while invertebrates were measured by carapace length or total length depending on the classification of the specimen. All fish and invertebrates were measured manually with measuring boards. The following water quality parameters were measured and recorded at each station using a Hydrolab Quanta by Hach Company: temperature (° C), salinity (PSS), dissolved oxygen (mg/L), pH, conductivity (mS/cm) and turbidity (NTU). Other observations recorded were GPS coordinates of the starting and ending points of each station, number of casts made per net, method of capture (i.e., random/non-random; cast net/scoop net); percent cloud cover and bottom or substrate composition (%). All introduced species and mortally wounded specimens were kept, while all native species were released back to the estuary. Any unidentifiable specimen was kept and preserved in 70% ethyl alcohol for identification. Any initial observations were also documented. These procedures were repeated for each station.

The Estuary Sampling Site, Honomanū Bay, is located in the region of Ke‘ānae, Maui. The watersheds (and watershed ID), region, and island surveyed in this report

Honomanū (ID: 64009), Ke‘ānae, Maui

Surveys were completed by these DAR staff:

Shimoda, Troy
Sakihara, Troy
Darrell, Kuamo‘o
Skippy Hau

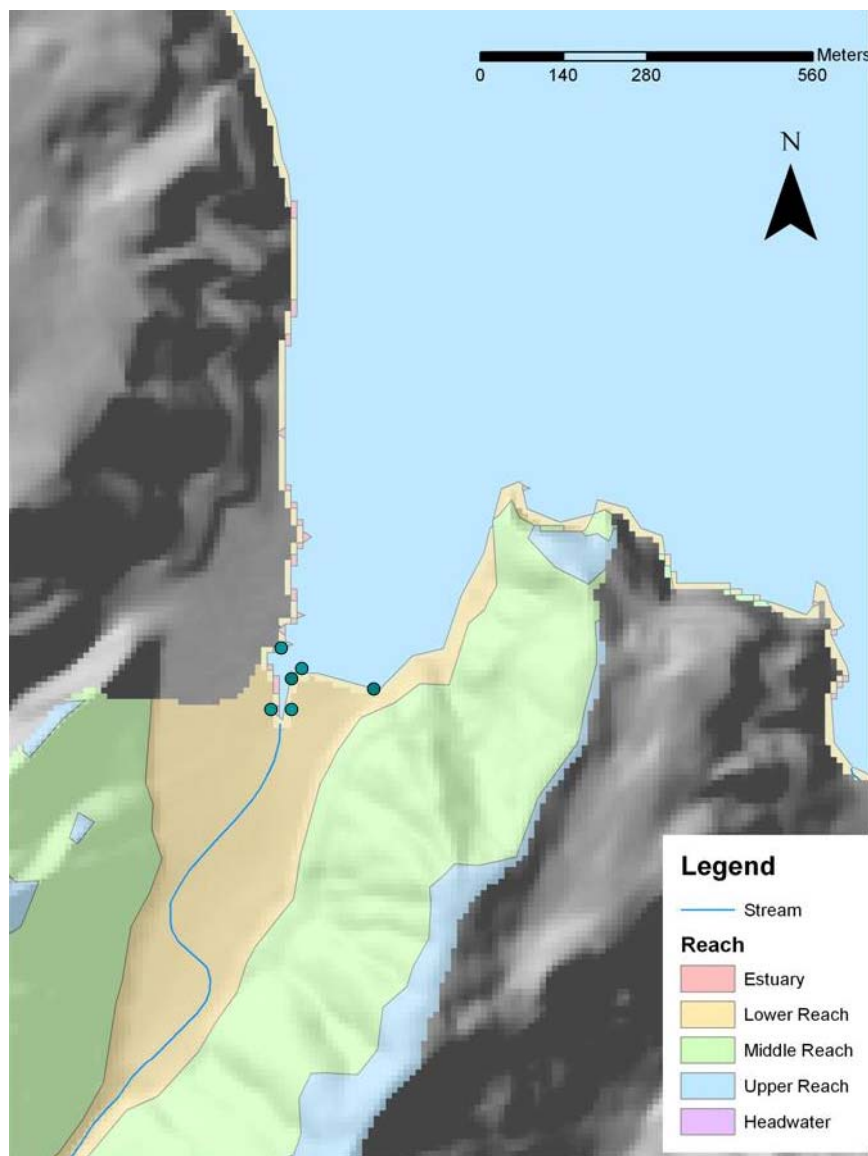


Figure 4-1. Location of estuary surveys conducted in Honomanū Bay.

Results

Table 4-1. Summary of the minimum, maximum, average, and the standard deviation of the depth observed in the survey stations in Honomanū Bay.

Location	Location ID	Depth min (cm)	Depth max (cm)	Depth avg (cm)	Depth Std dev. (cm)
Honomanū	13	40	60	53.333	10.328

Table 4-2. Summary of the observed substrate average(s) (%) in the survey stations in Honomanū Bay.

Avg Detritus	Avg Sediment	Avg Sand	Avg Gravel	Avg Boulder	Avg Bedrock
6.67	6.67	20.00	33.33	33.33	0.00

Table 4-3. Summary of the minimum, maximum, average, and the standard deviation of the dissolved oxygen observed in the survey stations in Honomanū Bay.

Location	Location ID	DO min (mg/L)	DO max (mg/L)	DO avg. (mg/L)	DO Std. Dev. (mg/L)
Honomanū	13	6.06	6.61	6.373	0.253

Table 4-4. Summary of the minimum, maximum, average, and the standard deviation of the pH observed in the survey stations in Honomanū Bay.

Location	Location ID	pH min	pH max	pH avg.	pH Std. Dev.
Honomanū	13	7.99	8.15	8.087	0.076

Table 4-5. Summary of the minimum, maximum, average, and the standard deviation of the salinity observed in the survey stations in Honomanū Bay.

Location	Location ID	Salinity min (ppt)	Salinity max (ppt)	Salinity avg. (ppt)	Salinity Std. Dev. (ppt)
Honomanū	13	3.75	30.47	17.6	11.974

Table 4-6. Summary of the minimum, maximum, average, and the standard deviation of the temperature observed in the survey stations in Honomanū Bay.

Location	Location ID	Temp min (° C)	Temp max (° C)	Temp avg. (° C)	Temp Std. Dev. (° C)
Honomanū	13	20.42	23.75	22.387	1.561

Table 4-7. Summary of the minimum, maximum, average, and the standard deviation of the turbidity observed in the survey stations in Honomanū Bay.

Location	Location ID	Turbidity min (NTU)	Turbidity max (NTU)	Turbidity avg. (NTU)	Turbidity Std. Dev. (NTU)
Honomanū	13	2.2	5.6	3.433	1.684

Table 4-8. Summary of species observed in the survey stations in Honomanū Bay.

Location	Location ID	Substation	Scientific Name	Category	Status	# of animals
Honomanū	13	1	<i>Kuhlia xenura</i>	Fish	Endemic	11
Honomanū	13	1	<i>Atherinomorus insularum</i>	Fish	Endemic	18
Honomanū	13	2	<i>Kuhlia xenura</i>	Fish	Endemic	19
Honomanū	13	2	<i>Atherinomorus insularum</i>	Fish	Endemic	9
Honomanū	13	2	<i>Valamugil engeli</i>	Fish	Introduced	1
Honomanū	13	3	<i>Kuhlia xenura</i>	Fish	Endemic	20
Honomanū	13	3	<i>Mugil cephalus</i>	Fish	Indigenous	22
Honomanū	13	3	<i>Valamugil engeli</i>	Fish	Introduced	17

Table 4-9. Summary of the minimum, maximum, average, and the standard deviation of the fork length in mm. of each species observed in survey station 1.

Station	Scientific Name	FL min (mm)	FL max (mm)	FL avg. (mm)	FL Std. Dev. (mm)
1	<i>Kuhlia xenura</i>	118	160	133.545	12.691
1	<i>Atherinomorus insularum</i>	73	88	81.389	4.175

Table 4-10. Summary of the minimum, maximum, average, and the standard deviation of the fork length in mm. of each species observed in survey station 2.

Station	Scientific Name	FL min (mm)	FL max (mm)	FL avg. (mm)	FL Std. Dev. (mm)
2	<i>Kuhlia xenura</i>	53	80	61.789	6.82
2	<i>Atherinomorus insularum</i>	74	89	81.556	6.464
2	<i>Valamugil engeli</i>	110	110	110	

Table 4-11. Summary of the minimum, maximum, average, and the standard deviation of the fork length in mm. of each species observed in survey station 3.

Station	Scientific Name	FL min (mm)	FL max (mm)	FL avg. (mm)	FL Std. Dev. (mm)
3	<i>Kuhlia xenura</i>	45	70	58.25	6.197
3	<i>Mugil cephalus</i>	89	132	115.909	10.332
3	<i>Valamugil engeli</i>	93	180	122.941	28.687

Summary

Estuary Surveys were conducted in Honomanū Bay on 8 December 2008. A total of 398 m of shoreline was surveyed in three discrete sections (170 m, 81 m, 147 m). Honomanū Bay was considerably larger in area compared to other estuaries sampled in East Maui. The physical conditions of Honomanū Bay consisted of boulder terrain with cobble and gravel near the mouth of Honomanū Stream in relatively calm water of a coastal embayment. The stream mouth was open although water flow was minimal. The species recorded in our samples were consistent with samples collected throughout other estuaries in the state, with some of the most common Hawaiian estuarine species recorded. However, sample sizes were small considering the size of the estuary.

Species observed in Honomanū Bay during 8 December 2008 surveys:

Native Species

Fish *Atherinomorus insularum*, **‘Iao**
 Kuhlia xenura, **Āholehole**
 Mugil cephalus, **‘Ama‘ama**

Introduced Species

Fish *Valamugil engeli*, **Kanda mullet**

Section 5: Photographs taken during stream surveys

Aerial Photographs



Figure 5-1. Photo shows the mouth of Honomanū stream. (6/28/2009; Tributary name: Honomanū (64009001); PBN tss64009001p-000-062809; Photo by: Sakihara, T.).

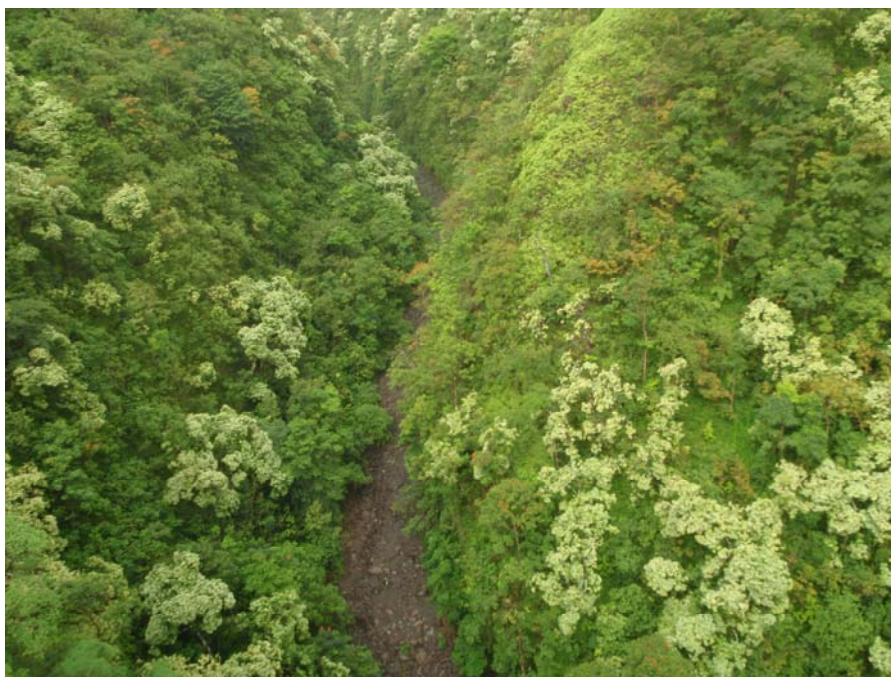


Figure 5-2. Photo shows Honomanū's dry stream bed. (6/28/2009; Tributary name: (64009003); PBN: sh64009003p-029-062809; Photo by: Hau, S.).



Figure 5-3. Photo of a dry waterfall taken in upper Honomanū Stream tributary. (6/28/2009; Tributary name: Honomanū (64009003); PBN: sh64009003p-034-062809; Photo by: Hau, S.).

Estuary and Lower Reach

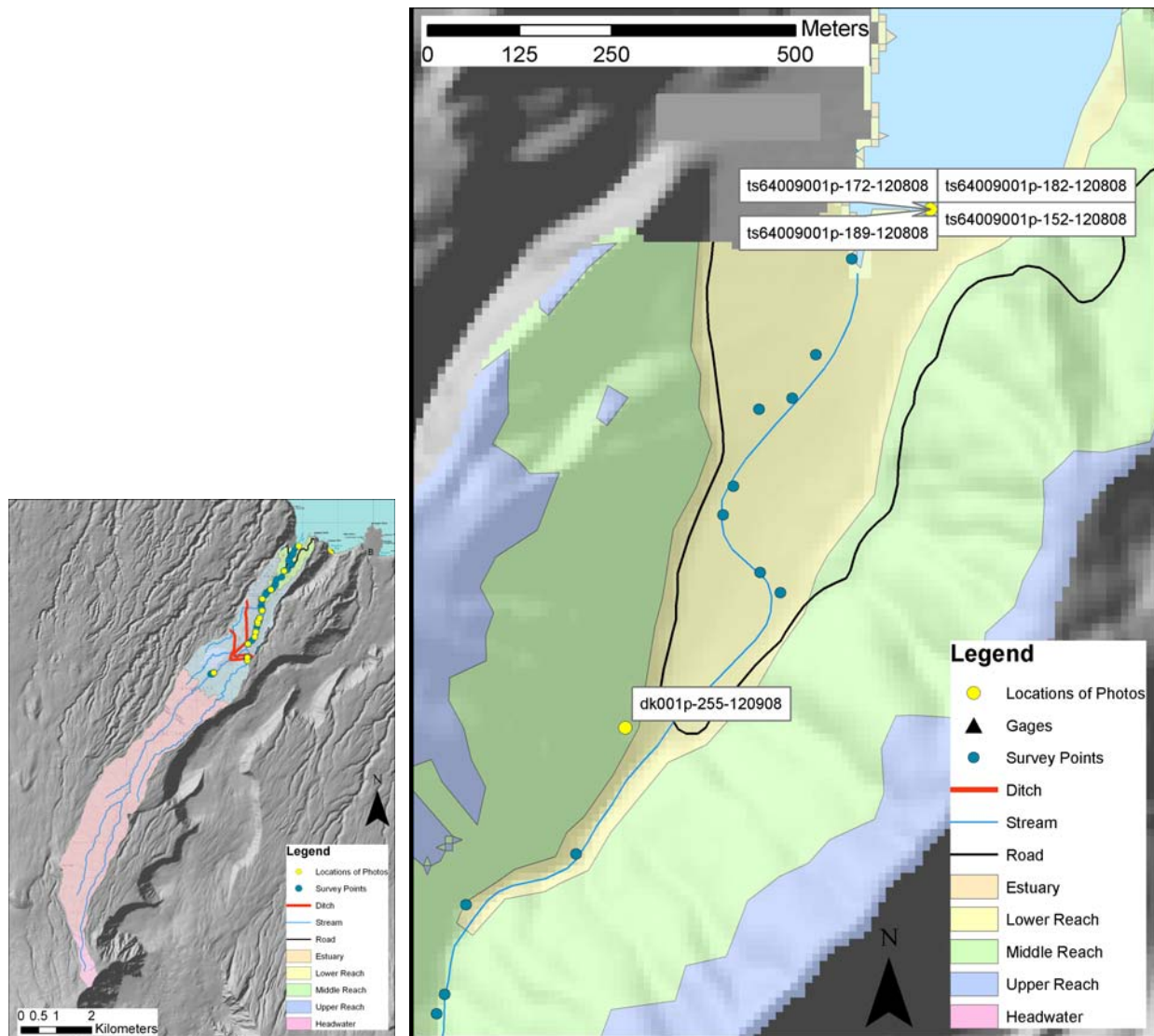


Figure 5-4. Photo locations in the estuary and lower reach of Honomanū Stream.

Estuary



Figure 5-5. Photo of DAR staff casting a throw net on the westside of the stream mouth. (12/8/2008; Tributary name: Honomanū (64009001); PBN: ts64009001p-204-120808; Lat. (DD): 20.86085, Long. (DD): -156.16606).



Figure 5-6. Photo of Honomanū stream mouth looking upstream from station 3. Photo oriented south at station 3. (12/8/2008; Tributary name: Honomanū (64009001); PBN: ts64009001p-200-120808; Lat. (DD): 20.86085, Long. (DD): -156.16606).



Figure 5-7. Photo of DAR surveyor casting a throw net into the estuary at Honomanū. Photo is oriented in an upstream direction. (12/8/2008; Tributary name: Honomanū (64009001); PBN: ts64009001p-189-120808; Lat. (DD): 20.86085, Long. (DD): -156.16606).



Figure 5-8. Photo of Honomanū Bay shoreline from station 1. Photo taken eastward from station 1. (12/8/2008; Tributary name: Honomanū (64009001); PBN: ts64009001p-182-120808; Lat. (DD): 20.86085, Long. (DD): -156.16606).



Figure 5-9. Photo of DAR estuarine surveyors identifying and measuring fish samples at station 1. Photo taken westward at station 1. (12/8/2008; Tributary name: Honomanū (64009001); PBN: ts64009001p-172-120808; Lat. (DD): 20.86085, Long. (DD): -156.16606).



Figure 5-10. Photo of the coastline of Honomanū Bay and estuary. (12/8/2008; Tributary name: Honomanū (64009001); PBN: ts64009001p-152-120808; Lat. (DD): 20.86085, Long. (DD): -156.16606).



Figure 5-11. Photo of DAR staff casting a throw net at the mouth of the stream. (12/8/2008; Tributary name: Honomanū (64009001); PBN: ts64009001p-213-120808; Lat. (DD): 20.86085, Long. (DD): -156.16606).

Lower reach



Figure 5-12. Photo of survey site 10. Upstream view from survey site. (6/28/2009; Tributary name: Honomanū (64009003); PBN: sh010p-068-062809; Surveyor: Hau, S.; Habitat type: Pool, SBN: sh010r-062809).



Figure 5-13. Photo of a dry stream bed and is taken in an upstream direction from survey site 1. (12/9/2008; Tributary name: Honomanū (64009001); PBN: dk001p-255-120908; Surveyor: Kuamo'o, D.; Habitat type: No Water; SBN: dk001r-120908; Lat. (DD): 20.85454, Long. (DD): -156.17017).

Middle Reach

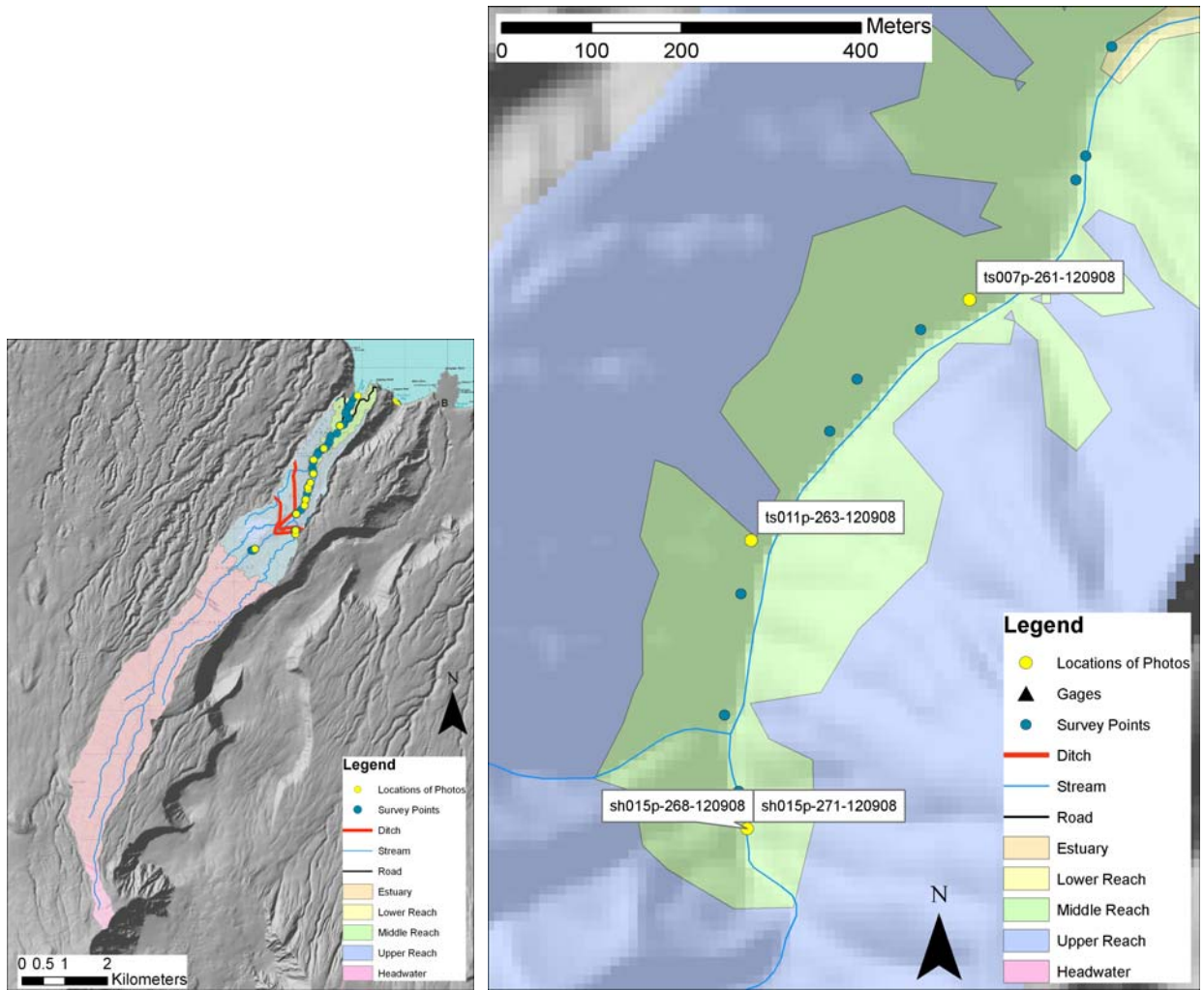




Figure 5-15. Photo of DAR staff conducting a stream survey at site 7. (12/9/2008; Tributary name: Honomanū (64009001); PBN: ts007p-261-120908; Surveyor: Shimoda, T.; Habitat type: No Water; SBN: ts007r-120908; Lat. (DD): 20.84987, Long. (DD): -156.17386).

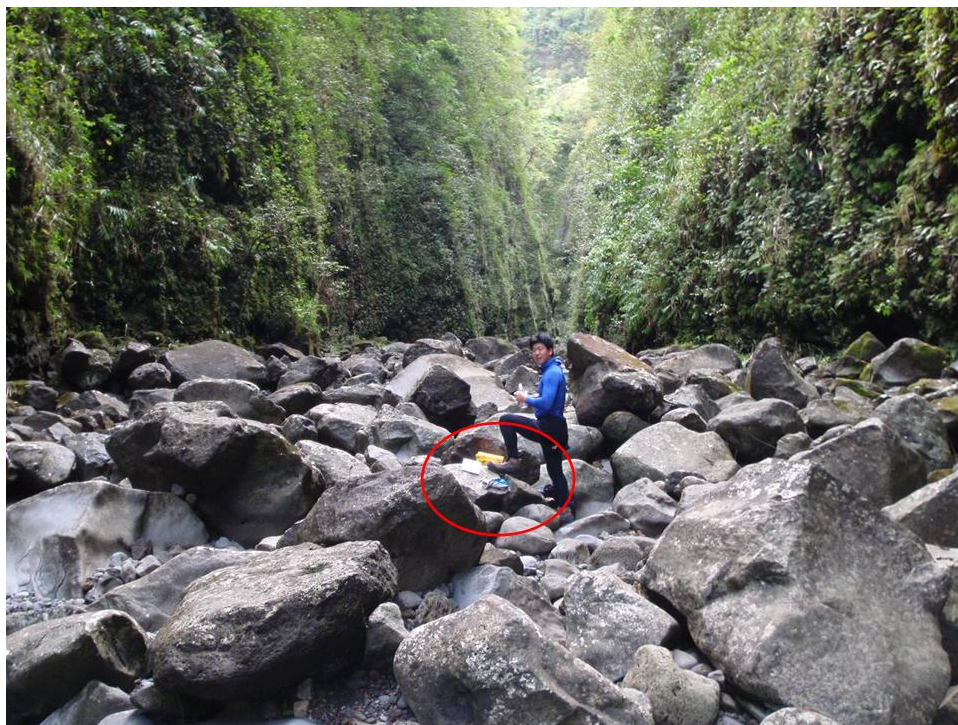


Figure 5-16. DAR staff surveying site 11. Photo oriented in an upstream direction. (12/9/2008; Tributary name: Honomanū (64009001); PBN: ts011p-263-120908; Surveyor: Shimoda, T.; Habitat type: No Water; SBN: ts011r-120908; Lat. (DD): 20.84749, Long. (DD): -156.17624).



Figure 5-17. Photo from the bottom of a dry waterfall from survey site 15. (12/9/2008; Tributary name: Honomanū (64009003); PBN: sh015p-268-120908; Surveyor: Hau, S.; Habitat type: Plunge Pool; SBN: sh015n-120908; Lat. (DD): 20.84458, Long. (DD): -156.17634).



Figure 5-18. Photo of survey site 15 taken in an upstream direction. Note the base of a dry waterfall. (12/9/2008; Tributary name: Honomanū (64009003); PBN: sh015p-271-120908; Surveyor: Hau, S.; Habitat type: Plunge Pool; SBN: sh015n-120908; Lat. (DD): 20.84458, Long. (DD): -156.17634).

Upper Reach

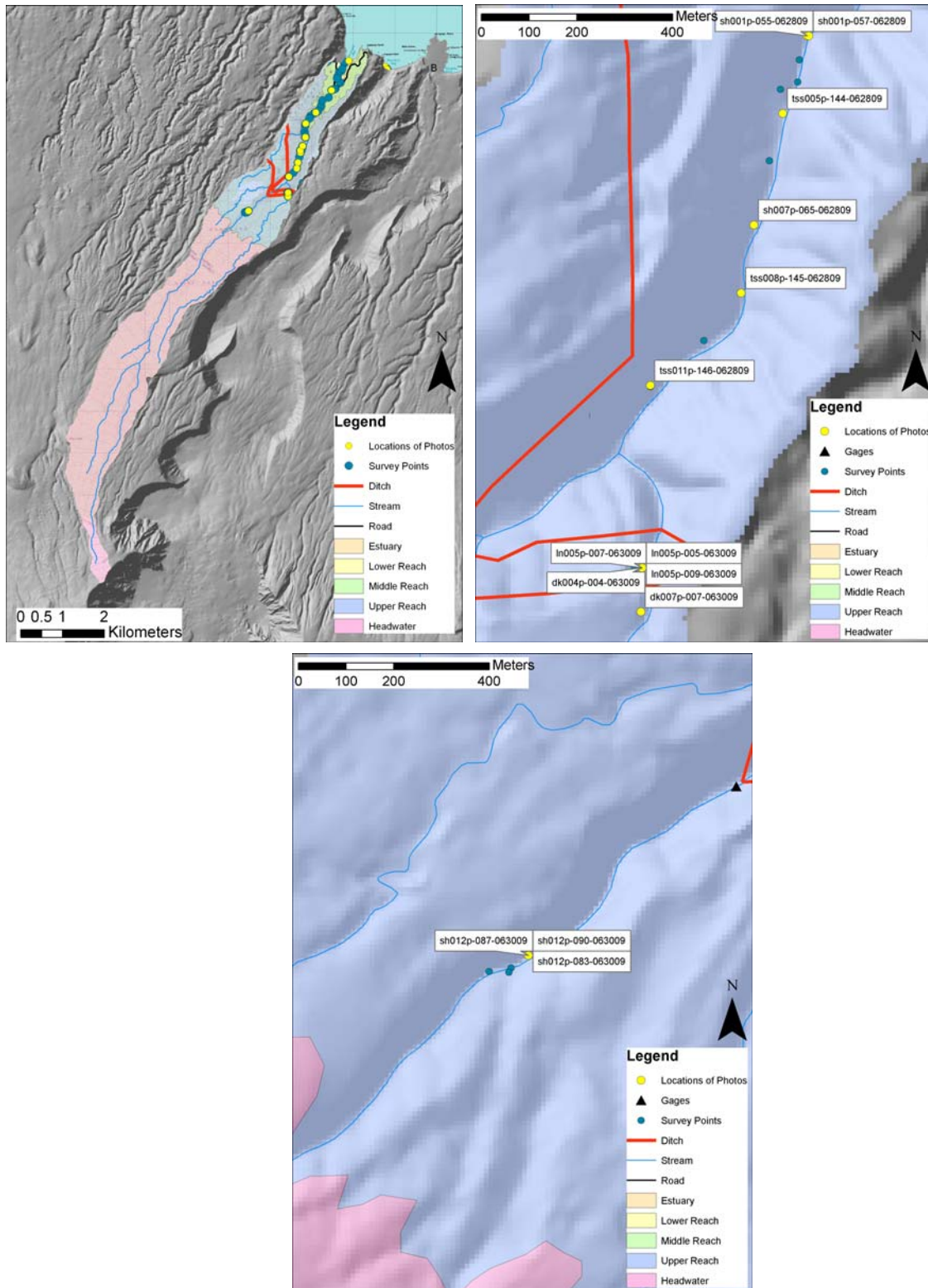


Figure 5-19. Photo locations in the upper reach of Honomanū Stream.



Figure 5-20. DAR staff taking flow measurement on Honomanū Stream below survey site 1. (6/28/2009; Tributary name: Honomanū (64009003); PBN: sh001p-055-062809; Surveyor: Hau, S.; SBN: 122; Lat. (DD): 20.84272, Long. (DD): -156.17705).



Figure 5-21. Photo of area surrounding survey site 1 taken in an upstream direction. Note the low water. (6/28/2009; Tributary name: Honomanū (64009003); PBN: sh001p-057-062809; Surveyor: Hau, S.; Habitat type: No Water; SBN: sh001r-062809; Lat. (DD): 20.84272, Long. (DD): -156.17702).



Figure 5-22. Photo of area surrounding survey site 5. (6/28/2009; Tributary name: Honomanū (64009003); PBN: tss005p-144-062809; Surveyor: Sakihara, T.; Habitat type: Side Pool; SBN: tss005r-062809; Lat. (DD): 20.84126, Long. (DD): -156.17757).



Figure 5-23. Photo of a dry stream be a survey site 7 looking upstream. (6/28/2009; Tributary name: Honomanū (64009003); PBN: sh007p-065-062809; Surveyor: Hau, S.; Habitat type: No Water; SBN: sh007r-062809; Lat. (DD): 20.83916, Long. (DD): -156.17819).



Figure 5-24. Photo of dry stream bed at survey site 8. (6/28/2009; Tributary name: Honomanū (64009003); PBN: tss008p-145-062809; Surveyor: Sakihara, T.; Habitat type: No Water; SBN: tss008r-062809; Lat. (DD): 20.83788, Long. (DD): -156.17847).



Figure 5-25. Photo of waterfall with minimal flow above plunge pool in Honomanū Stream at survey site 11. Photo by Troy Sakihara upstream at site 11n. (6/28/2009; Tributary name: Honomanū (64009003); PBN: tss011p-146-062809; Surveyor: Sakihara, T.; Habitat type: Plunge Pool; SBN: tss011n-062809; Lat. (DD): 20.83616, Long. (DD): -156.18033).



Figure 5-26. Photo of a bridge crossing. (6/30/2009; Tributary name: Honomanū (64009004); PBN: dk004p-004-063009; Surveyor: Kuamo‘o, D.; SBN: dk001d-063009; Lat. (DD): 20.83271, Long. (DD): -156.18056).



Figure 5-27. Diversion downstream of site 5 and taken on the right side facing upstream. (6/30/2009; Tributary name: Honomanū (64009004); PBN: ln005p-009-063009; Surveyor: Nishiura, L.; SBN: ln005d-063009; Lat. (DD): 20.83271, Long. (DD): -156.18056).



Figure 5-28. Photo of diversion on Honomanū Stream taken downstream of site 5. (6/30/2009; Tributary name: Honomanū (64009004); PBN: ln005p-007-063009; Surveyor: Nishiura, L.; SBN: ln005d-063009; Lat. (DD): 20.83271, Long. (DD): -156.18056).

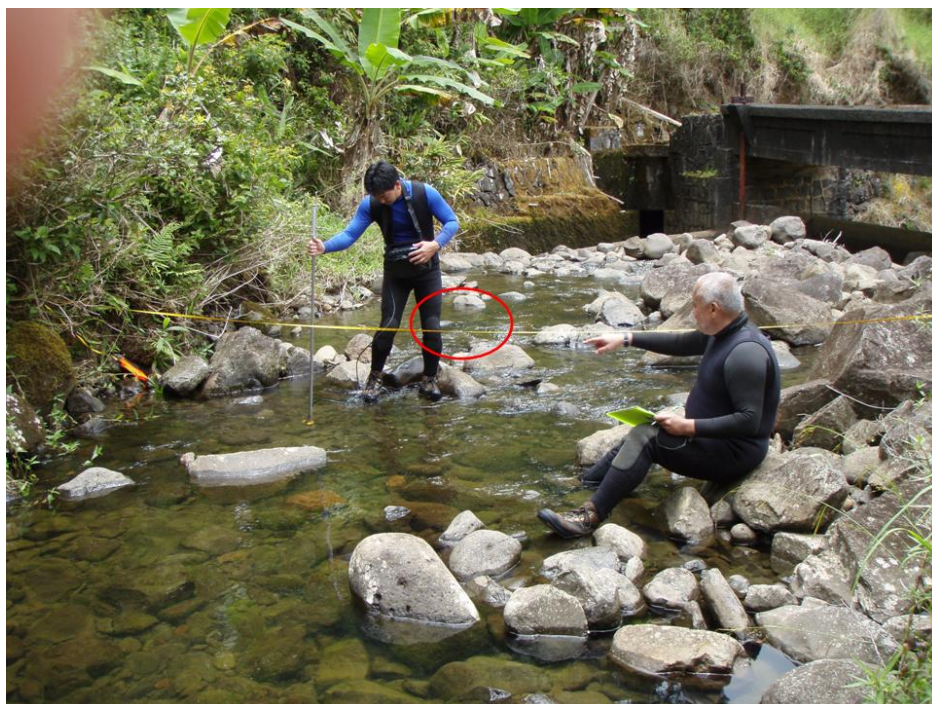


Figure 5-29. DAR surveyors taking flow data at Honomanū Stream. Survey site 5 is located directly downstream of the flow measurement. (6/30/2009; Tributary name: (64009004); PBN: ln005p-005-063009; Surveyor: Nishiura, L.; SBN: 132; Lat. (DD): 20.83271, Long. (DD): -156.18056).



Figure 5-30. W located above survey site 7. (6/30/2009; Tributary name: Honomanū (64009004); PBN: dk007p-007-063009; Surveyor: Kuamo‘o, D.; Habitat type: Plunge Pool; SBN: dk007r-063009; Lat. (DD): 20.83188, Long. (DD): -156.1806).



Figure 5-31. View of the stream downstream of the flow measurement and survey site. (6/30/2009; Tributary name: (64009007); PBN: sh012p-087-063009; Surveyor: Hau, S.; SBN: 126; Lat. (DD): 20.82894; Long. (DD): -156.18977).



Figure 5-32. Flow measurement site. (6/30/2009; Tributary name: (64009007); PBN: sh012p-083-063009; Surveyor: Hau, S.; SBN: 126; Lat. (DD): 20.82894, Long. (DD):-156.18977).



Figure 5-33. Photo taken in an upstream direction from survey site 12 showing where the flow measurement was conducted. (6/30/2009; Tributary name: Honomanū (64009007); PBN: sh012p-090-063009; Surveyor: Hau, S.; Habitat type: Riffle; SBN: sh012r-063009; Lat. (DD): 20.82894, Long. (DD): -156.18977).

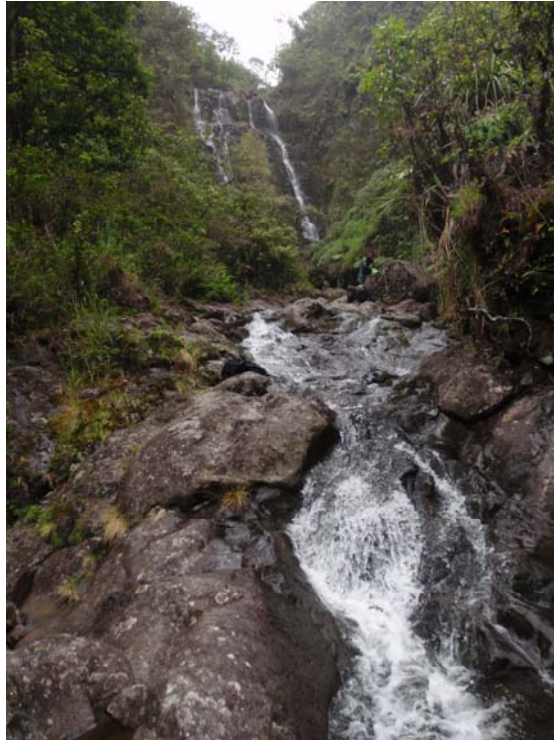


Figure 5-34. Photo is taken upstream of survey site 12. (6/30/2009; Tributary name: Honomanū (64009007); PBN: sh64009007p-092-063009; Photo by: Hau, S.).

References

- Gingerich, S.B. and R.H. Wolff. 2005. Effects of Surface-Water Diversions on Habitat Availability for Native Macrofauna, Northeast Maui, Hawai‘i.
- Hawai‘i Division of Aquatic Resources. 2008. DAR Point Quadrat Survey Data from the DAR Aquatic Surveys Database.
- Juvik, S.P. and J.O. Juvik. 1998. Atlas of Hawai‘i. University of Hawaii Press.
- Pukui, M.K. and S.H. Elbert. 1971. Hawaiian Dictionary. University of Hawaii Press
- Pukui, M.K., S.H. Elbert and E.T. Mookini. 1976. Place Names of Hawaii. University of Hawaii Press.

Blank Page

Appendix: Survey Sites Latitude and Longitude

Tributary	Stream	Survey Book #	Site	Surveyor	Date	Latitude	Longitude
64009001	Honomanū	sh001x-120808	1	Hau, Skippy	12/8/2008	20.86063	-156.16714
64009001	Honomanū	sh001r-120808	1	Hau, Skippy	12/8/2008	20.86063	-156.16714
64009001	Honomanū	dk002r-120808	2	Kuamo'o, Darrell	12/8/2008	20.86026	-156.16710
64009001	Honomanū	tss003r-120808	3	Sakihara, Troy	12/8/2008	20.85909	-156.16759
64009001	Honomanū	sh004r-120908	4	Hau, Skippy	12/8/2008	20.85130	-156.17259
64009001	Honomanū	ts004r-120808	4	Shimoda, Troy	12/8/2008	20.85856	-156.16791
64009001	Honomanū	sh005r-120808	5	Hau, Skippy	12/8/2008	20.85843	-156.16835
64009001	Honomanū	dk006r-120808	6	Kuamo'o, Darrell	12/8/2008	20.85749	-156.16870
64009001	Honomanū	tss007r-120808	7	Sakihara, Troy	12/8/2008	20.85714	-156.16884
64009001	Honomanū	ts008r-120808	8	Shimoda, Troy	12/8/2008	20.85642	-156.16837
64009001	Honomanū	sh009n-120808	9	Hau, Skippy	12/8/2008	20.85617	-156.16811
64009001	Honomanū	sh009x-120808	9	Hau, Skippy	12/8/2008	20.85617	-156.16811
64009001	Honomanū	dk010r-120808	10	Kuamo'o, Darrell	12/8/2008	20.85483	-156.16925
64009001	Honomanū	ts011r-120808	11	Shimoda, Troy	12/8/2008	20.85476	-156.16962
64009001	Honomanū	dk001r-120908	1	Kuamo'o, Darrell	12/9/2008	20.85454	-156.17017
64009001	Honomanū	ts003r-120908	3	Shimoda, Troy	12/9/2008	20.85240	-156.17229
64009001	Honomanū	dk005r-120908	5	Kuamo'o, Darrell	12/9/2008	20.85106	-156.17270
64009001	Honomanū	tss005r-120908	5	Sakihara, Troy	12/9/2008	20.85300	-156.17084
64009001	Honomanū	tss006r-120908	6	Sakihara, Troy	12/9/2008	20.85015	-156.17336
64009001	Honomanū	ts007r-120908	7	Shimoda, Troy	12/9/2008	20.84987	-156.17386
64009001	Honomanū	sh008r-120908	8	Hau, Skippy	12/9/2008	20.84958	-156.17439
64009001	Honomanū	dk009r-120908	9	Kuamo'o, Darrell	12/9/2008	20.84909	-156.17508
64009001	Honomanū	tss010r-120908	10	Sakihara, Troy	12/9/2008	20.84857	-156.17538
64009001	Honomanū	ts011r-120908	11	Shimoda, Troy	12/9/2008	20.84749	-156.17624
64009001	Honomanū	sh012r-120908	12	Hau, Skippy	12/9/2008	20.84695	-156.17636
64009002	Honomanū	dk013r-120908	13	Kuamo'o, Darrell	12/9/2008	20.84573	-156.17656

Appendix: Survey Sites Latitude and Longitude (continued)

Tributary	Stream	Survey Book #	Site	Surveyor	Date	Latitude	Longitude
64009003	Honomanū	tss014r-120908	14	Sakihara, Troy	12/9/2008	20.84496	-156.17642
64009003	Honomanū	sh015n-120908	15	Hau, Skippy	12/9/2008	20.84458	-156.17634
64009003	Honomanū	sh015x-120908	15	Hau, Skippy	12/9/2008	20.84458	-156.17634
64009003	Honomanū	sh010x-062809		Hau, Skippy	6/28/2009		
64009003	Honomanū	sh012x-062809		Hau, Skippy	6/28/2009	20.83614	-156.18033
64009003	Honomanū	sh001r-062809	1	Hau, Skippy	6/28/2009	20.84272	-156.17702
64009003	Honomanū	tss002n-062809	2	Sakihara, Troy	6/28/2009	20.84227	-156.17722
64009003	Honomanū	tts003n-062809	3	Shindo, Tim	6/28/2009	20.84185	-156.17726
64009003	Honomanū	sh004n-062809	4	Hau, Skippy	6/28/2009	20.84172	-156.17761
64009003	Honomanū	sh004r-062809	4	Hau, Skippy	6/28/2009	20.84172	-156.17761
64009003	Honomanū	tss005r-062809	5	Sakihara, Troy	6/28/2009	20.84126	-156.17757
64009003	Honomanū	tts006r-062809	6	Shindo, Tim	6/28/2009	20.84037	-156.17786
64009003	Honomanū	sh007r-062809	7	Hau, Skippy	6/28/2009	20.83916	-156.17819
64009003	Honomanū	tss008r-062809	8	Sakihara, Troy	6/28/2009	20.83788	-156.17847
64009003	Honomanū	tts009r-062809	9	Shindo, Tim	6/28/2009	20.83699	-156.17924
64009003	Honomanū	sh010r-062809	10	Hau, Skippy	6/28/2009		
64009003	Honomanū	tss011n-062809	11	Sakihara, Troy	6/28/2009	20.83616	-156.18033
64009003	Honomanū	sh012n-062809	12	Hau, Skippy	6/28/2009	20.83614	-156.18033
64009004	Honomanū	ln005x-063009		Nishiura, Lance	6/30/2009	20.83271	-156.18056
64009004	Honomanū	dk004r-063009	4	Kuamo'o, Darrell	6/30/2009	20.83270	-156.18071
64009004	Honomanū	ln005r-063009	5	Nishiura, Lance	6/30/2009	20.83271	-156.18056
64009004	Honomanū	ts006r-063009	6	Shimoda, Troy	6/30/2009	20.83225	-156.18036
64009004	Honomanū	dk007r-063009	7	Kuamo'o, Darrell	6/30/2009	20.83188	-156.18060
64009007	Honomanū	sh012r-063009	12	Hau, Skippy	6/30/2009	20.82894	-156.18977

Appendix: Survey Sites Latitude and Longitude (continued)

<u>Tributary</u>	<u>Stream</u>	<u>Survey Book #</u>	<u>Site</u>	<u>Surveyor</u>	<u>Date</u>	<u>Latitude</u>	<u>Longitude</u>
64009007	Honomanū	tss013r-063009	13	Sakihara, Troy	6/30/2009	20.82871	-156.19013
64009007	Honomanū	tts014r-063009	14	Shindo, Tim	6/30/2009	20.82863	-156.19017
64009007	Honomanū	sh015n-063009	15	Hau, Skippy	6/30/2009	20.82865	-156.19057
64009007	Honomanū	sh015r-063009	15	Hau, Skippy	6/30/2009	20.82865	-156.19057

Blank Page