

DAR Stream Surveys *in the* East Maui Watershed *2007–2008*



Hawaii's Division of Aquatic Resources



Primary steward for all living freshwater, estuarine and marine resources in the State of Hawaii

Budget and Staffing

approximately 115 staff



**Field offices on Kauai,
Molokai, Maui, and Hawaii
(Hilo + Kona)**

Budget of \$10 million/year

**\$~6 million/year is federal
funding from Depts. of Interior
and Commerce**

**\$~4 million/year from State
General Fund**

Hawaiian Streams and their Biota

Distinctive stream characteristics

Narrow catchments, flashy flows, steep profiles

9 native stream macrofaunal elements

5 fish, 2 crustaceans, 2 molluscs

All have an amphidromous life cycle

Also 200+ microfaunal elements (insects, etc.)

60+ alien macrofaunal elements

Before 1980 - deliberate introductions

After 1980 - aquarium & aquaculture escapees

Threats

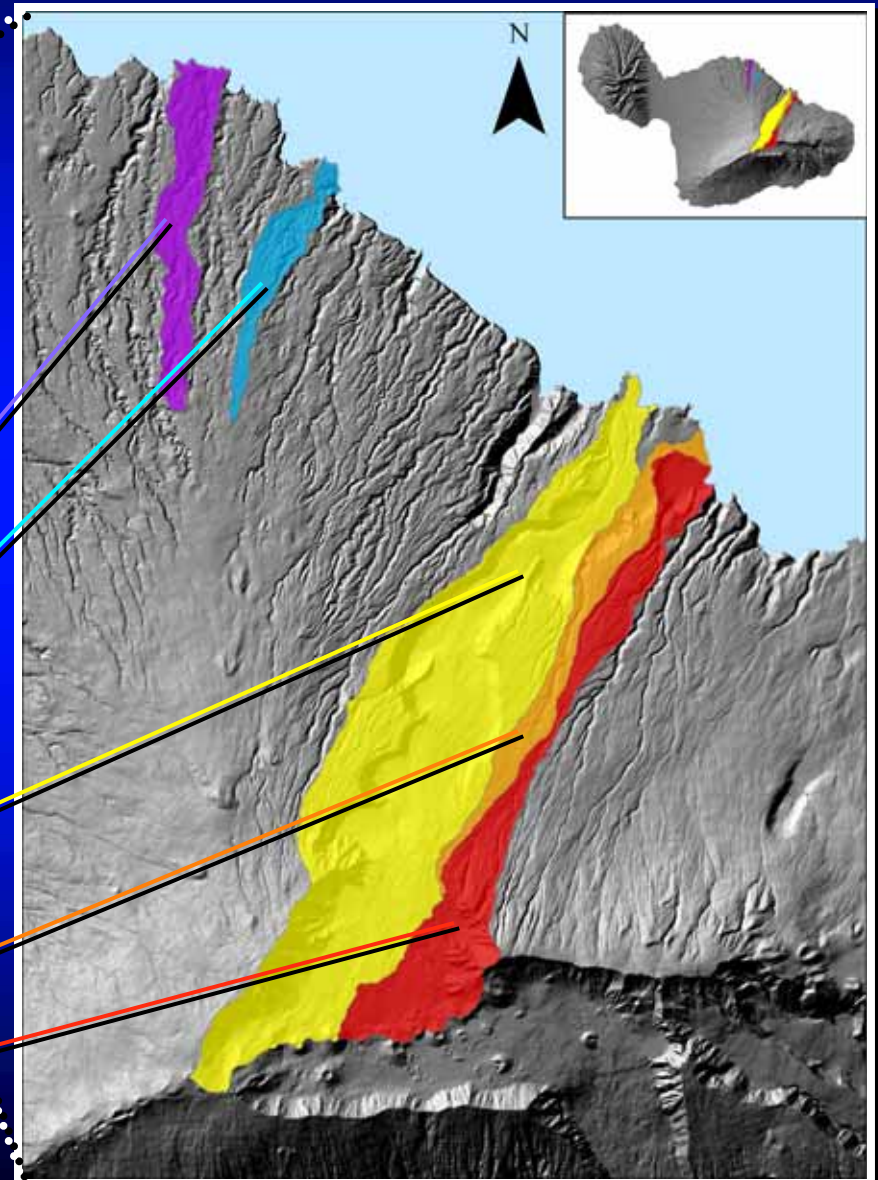
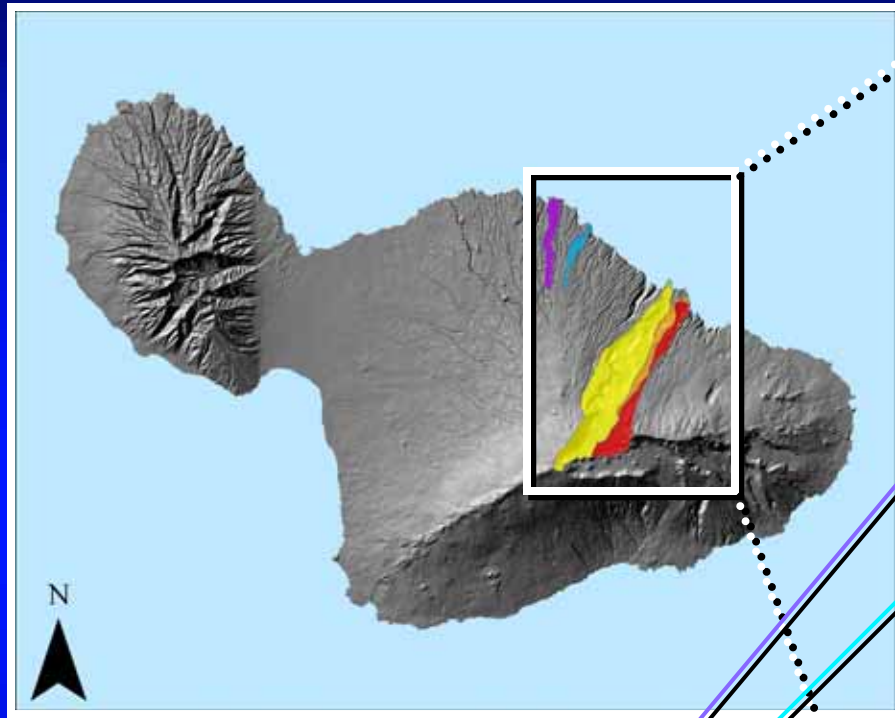
Loss of *mauka-makai* connectivity

Loss of natural flow profile

Aquatic invasive species



Five Target Streams



Honopou
Hanehoi
Piinaau
Waiokamilo
Wailuanui

Data Sources

Atlas of Hawaiian Watersheds

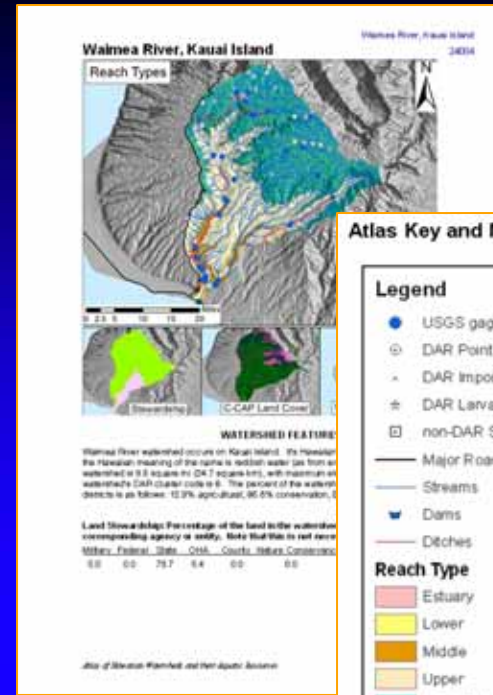
Comprehensive summary of existing knowledge

Now available online to public and decision makers

Supplemental Field Surveys

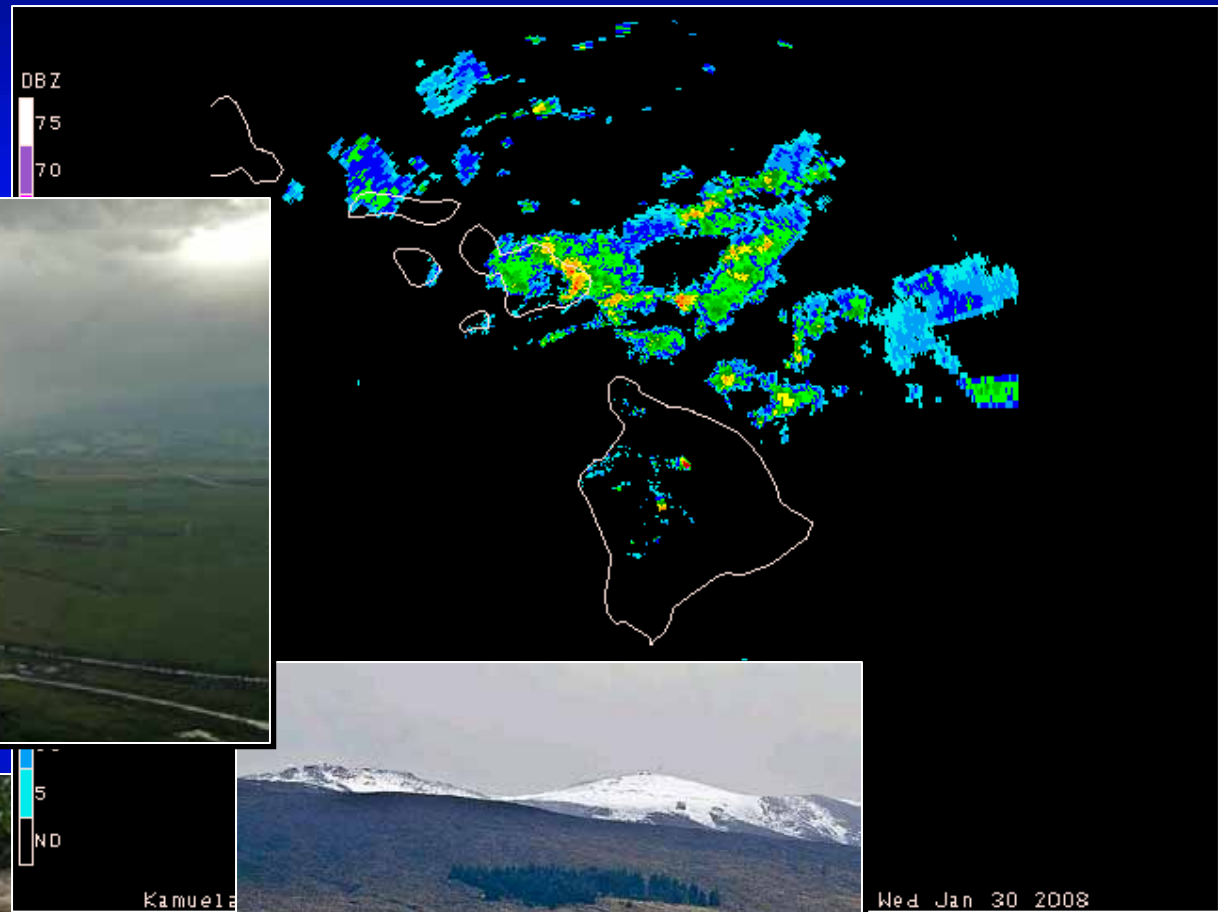
Over 3000 man-hours of field work in the 5 target stream catchments

Survey work involved 12 hour days in rough terrain



Constraints to Field Surveys

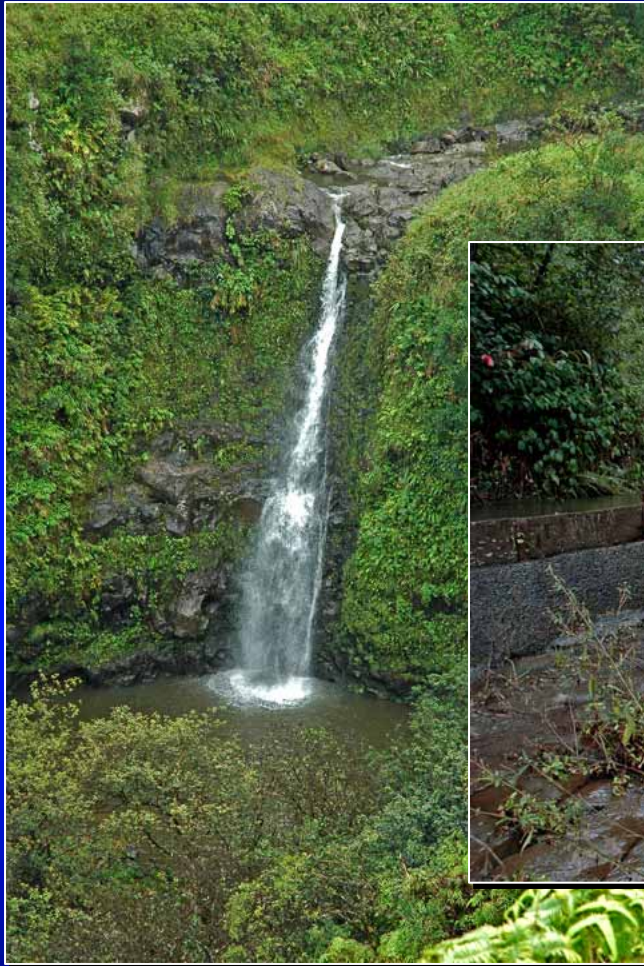
Weather



Wed Jan 30 2008

Constraints to Field Surveys

*Challenging
Topography*



*Difficult
Roads*

Constraints to Field Surveys



January 2008

Middle Honopou Stream

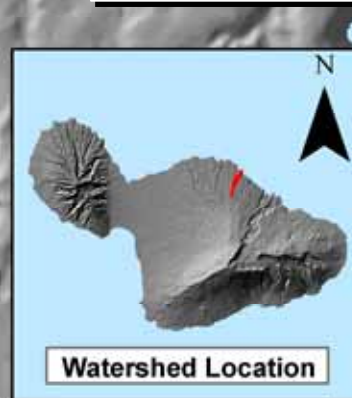
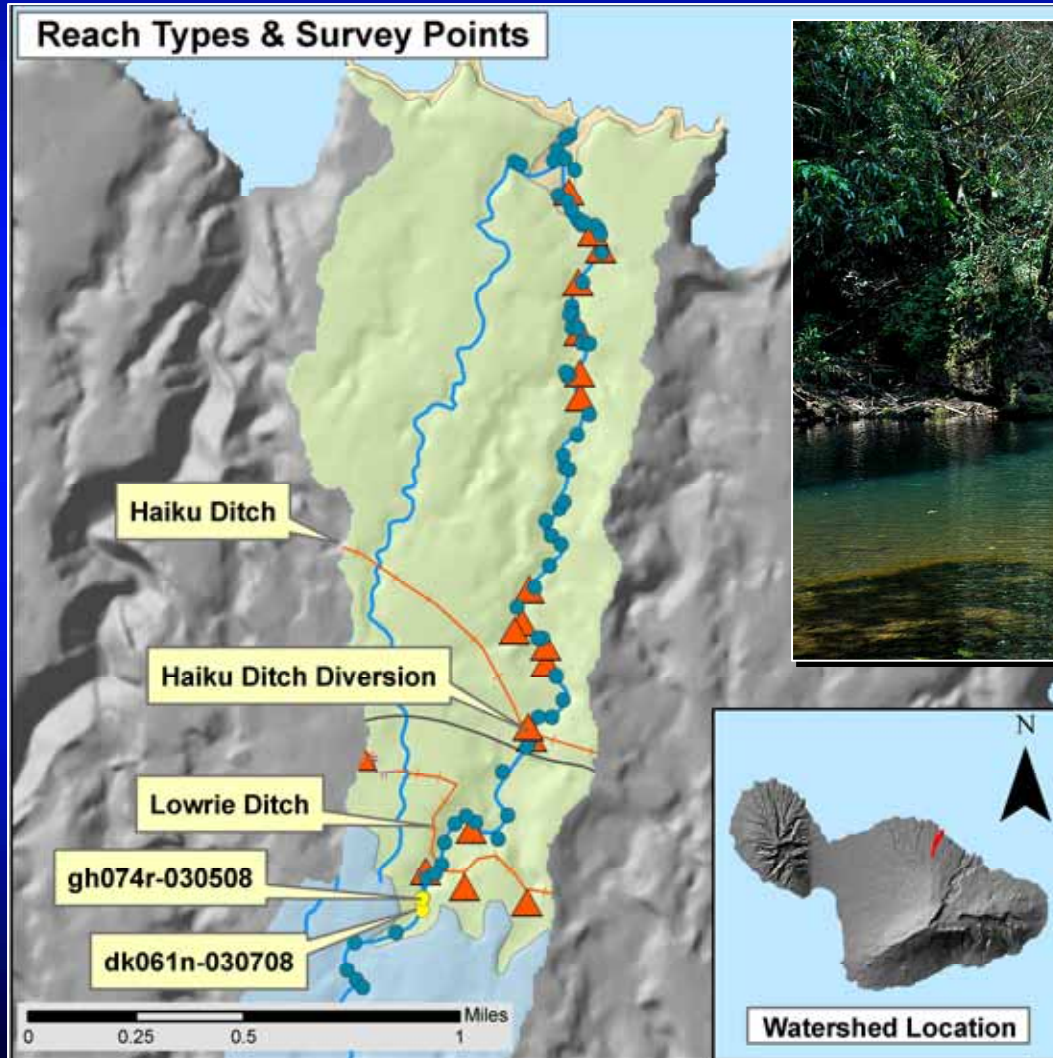
*Unpredictable
Stream
Conditions*



May 2008

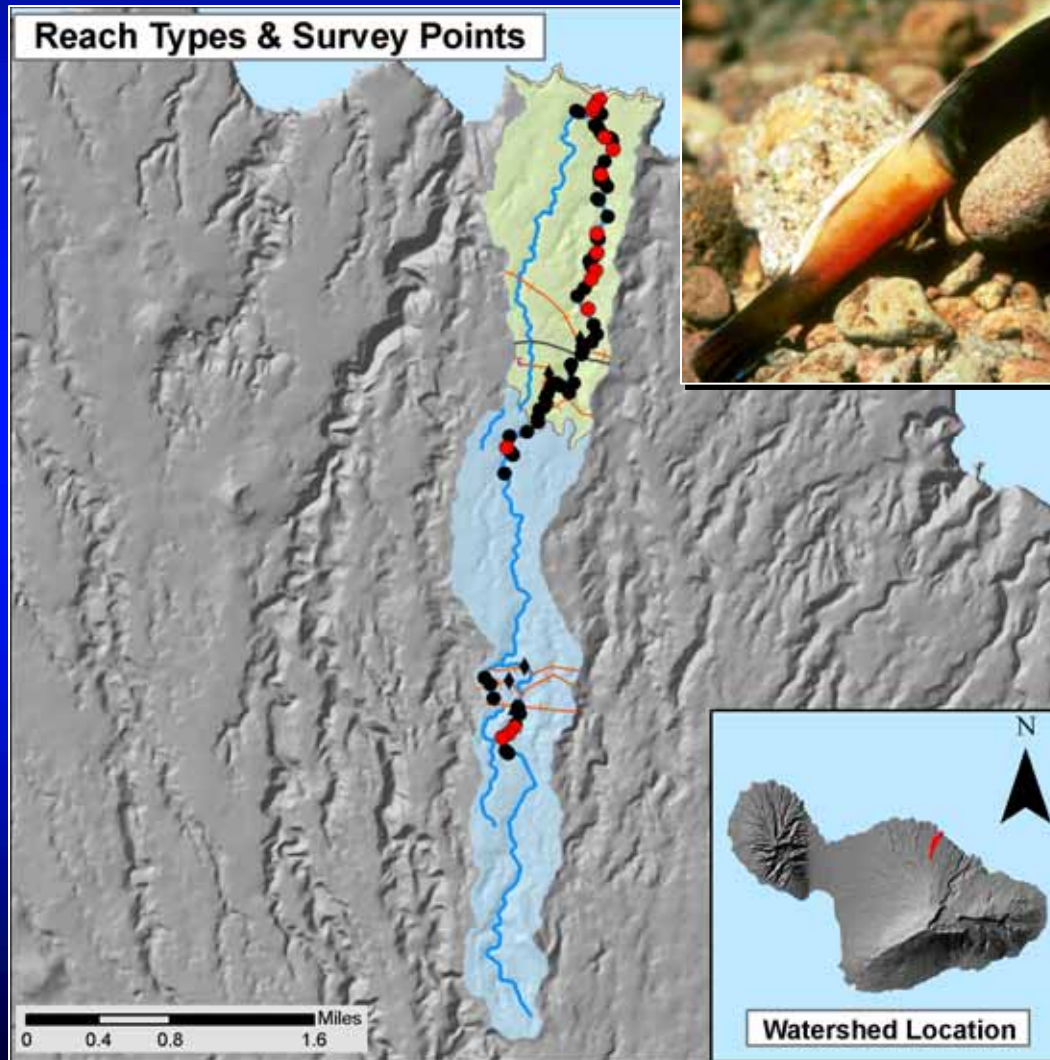
Honopou Stream

Survey Sites



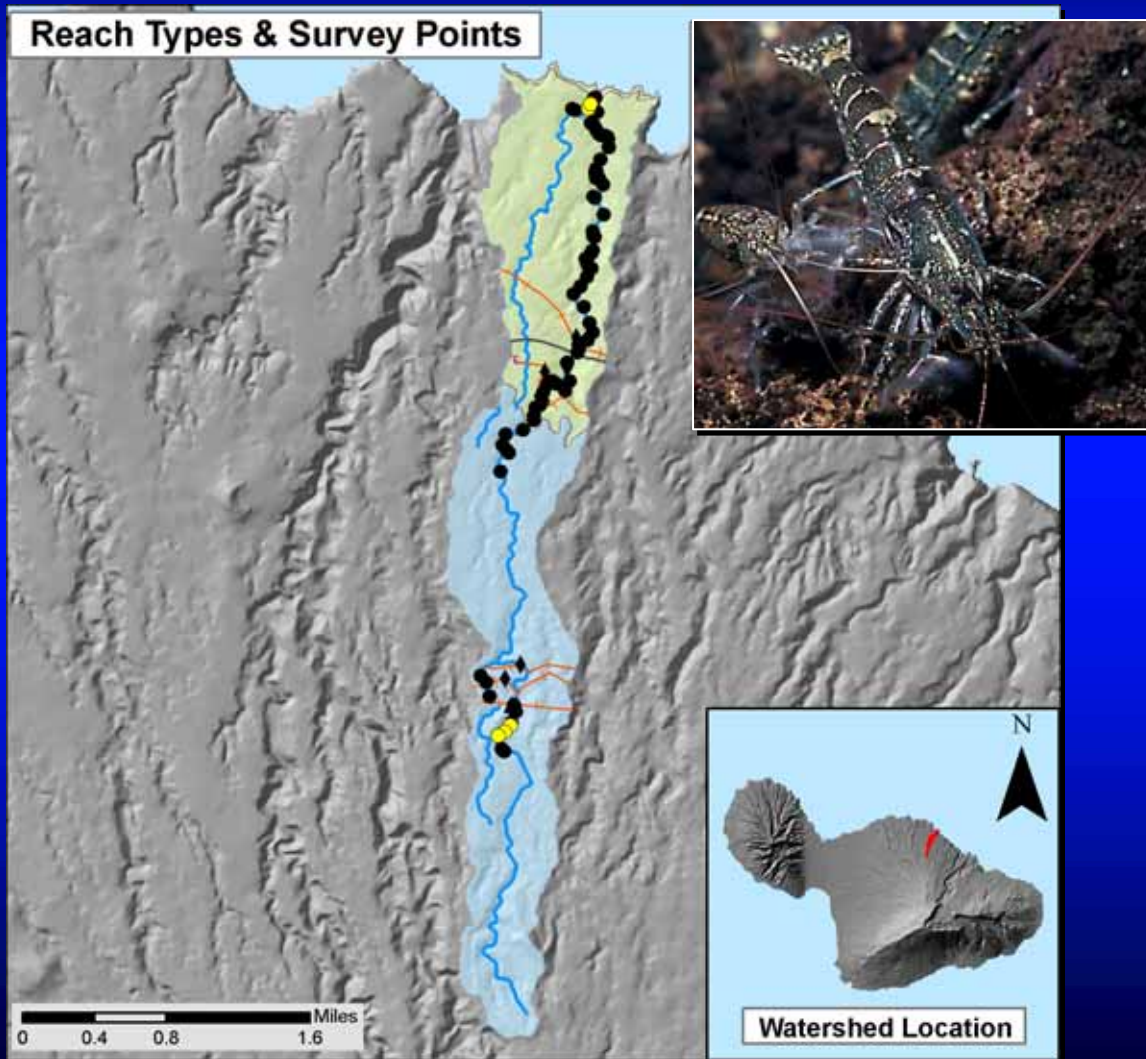
Honopou Stream

Fishes



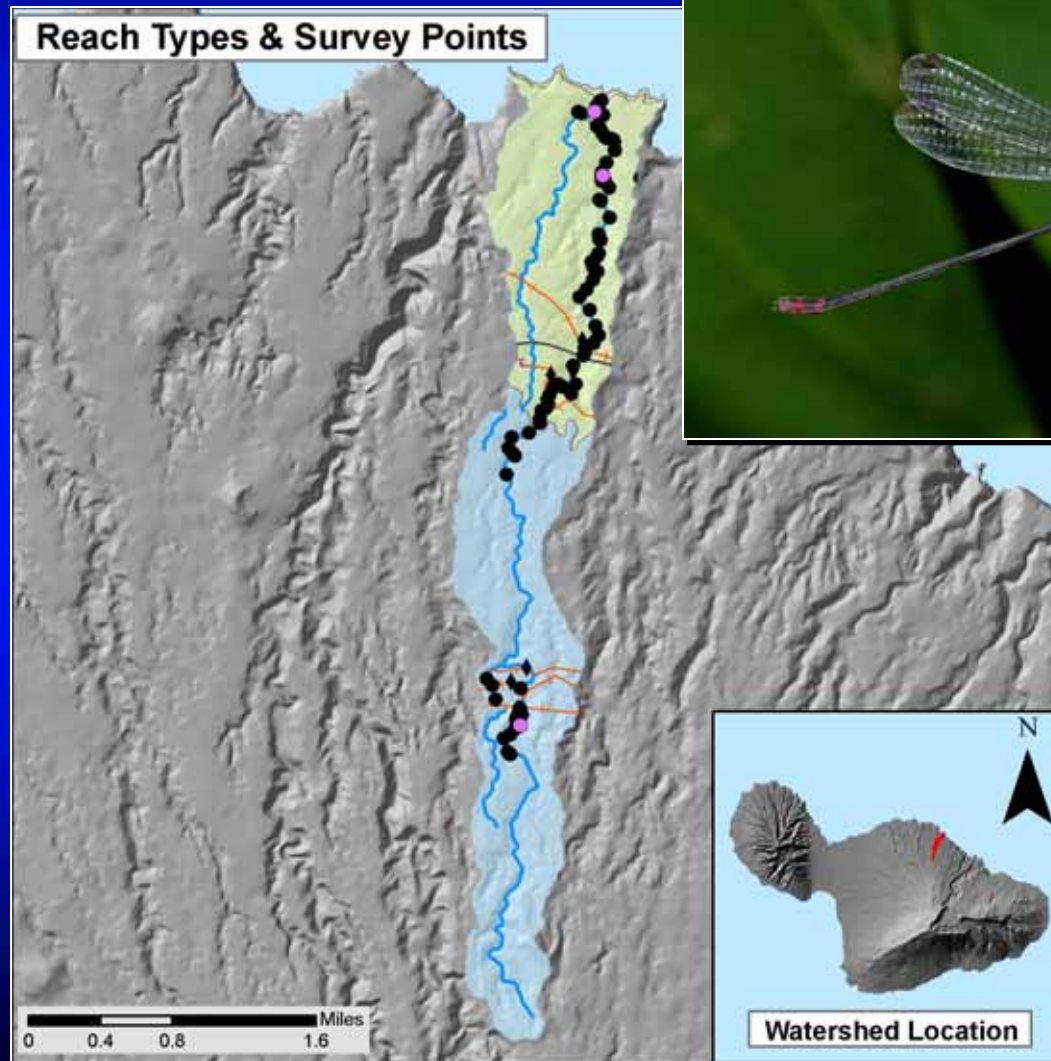
Honopou Stream

Crustaceans



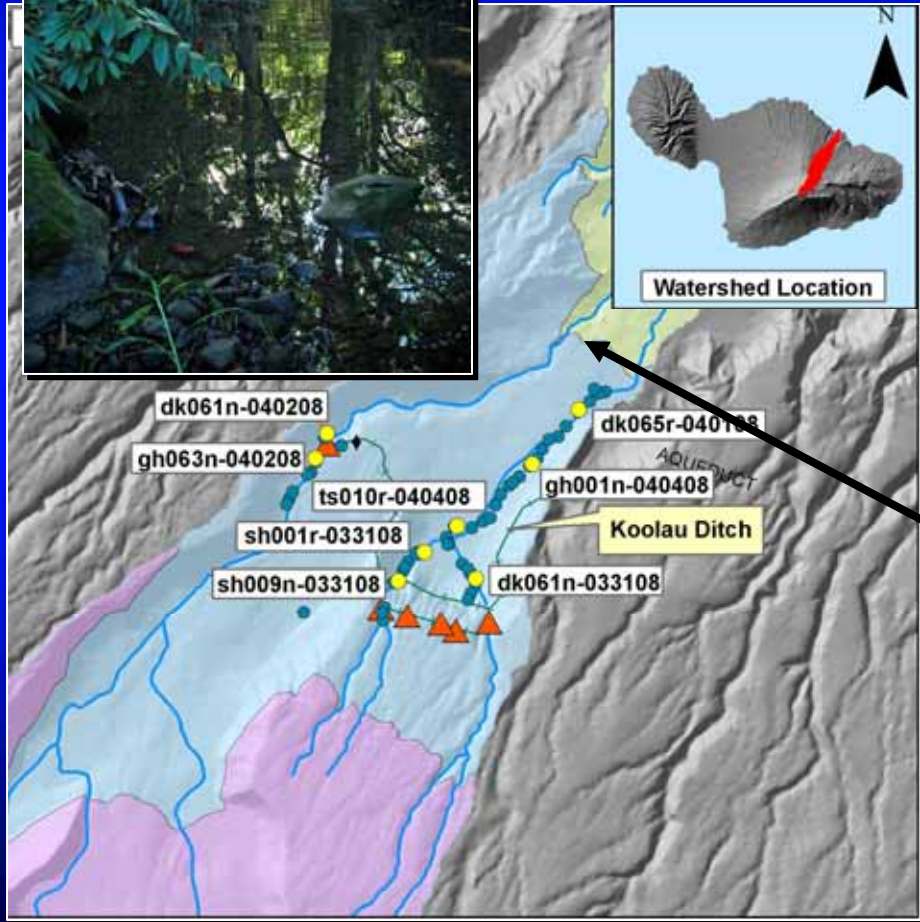
Honopou Stream

Stream Insects

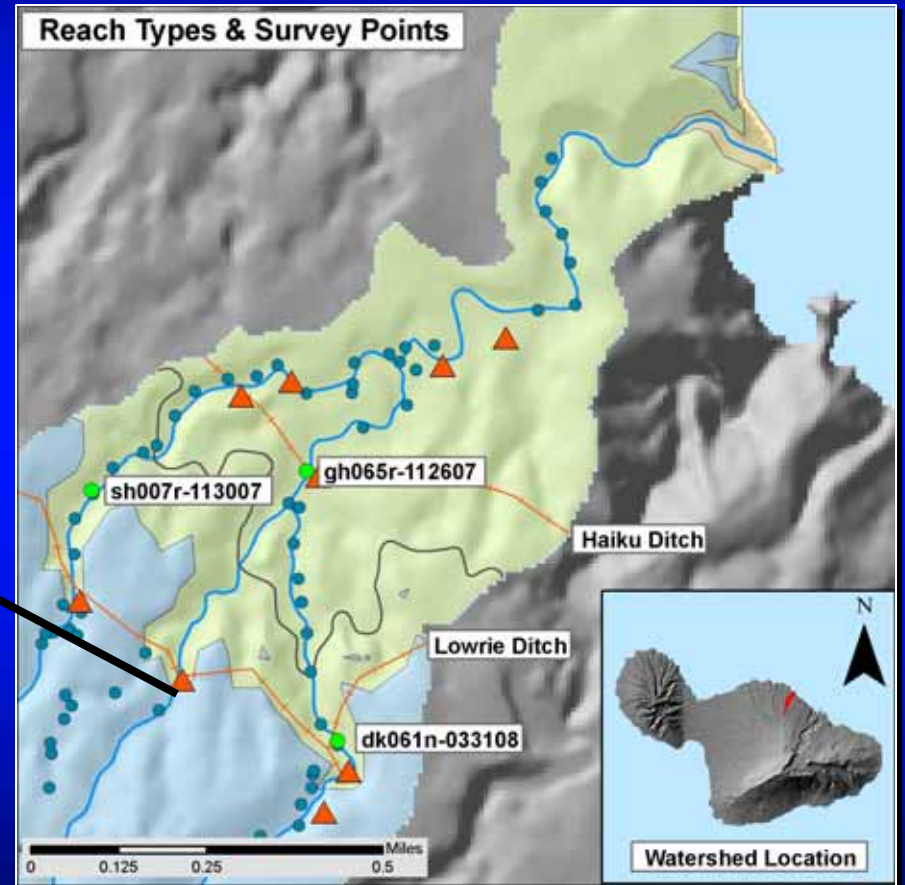


Hanehoi Stream

Survey Sites



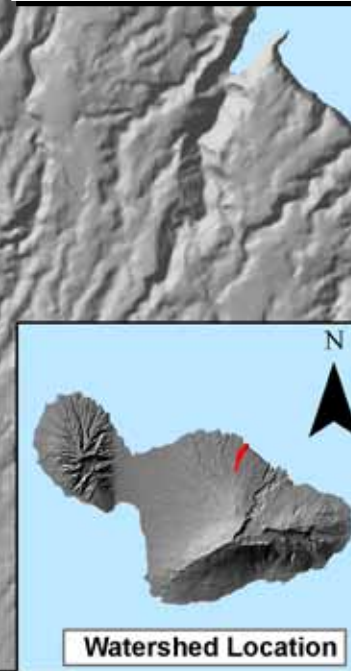
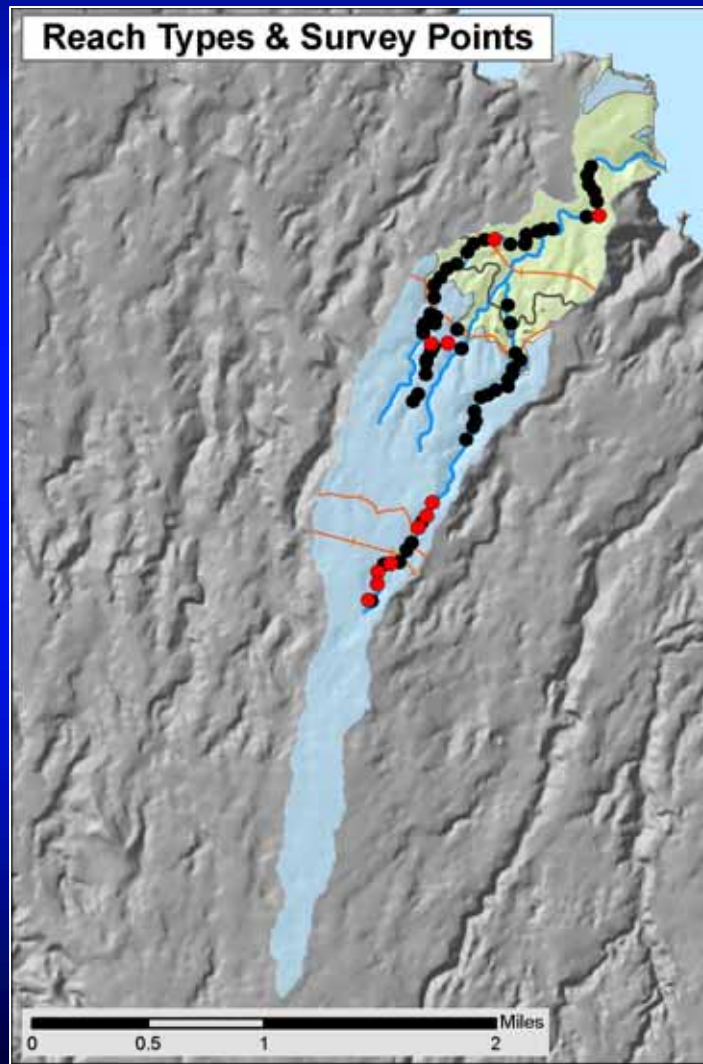
Upper catchment



Lower catchment

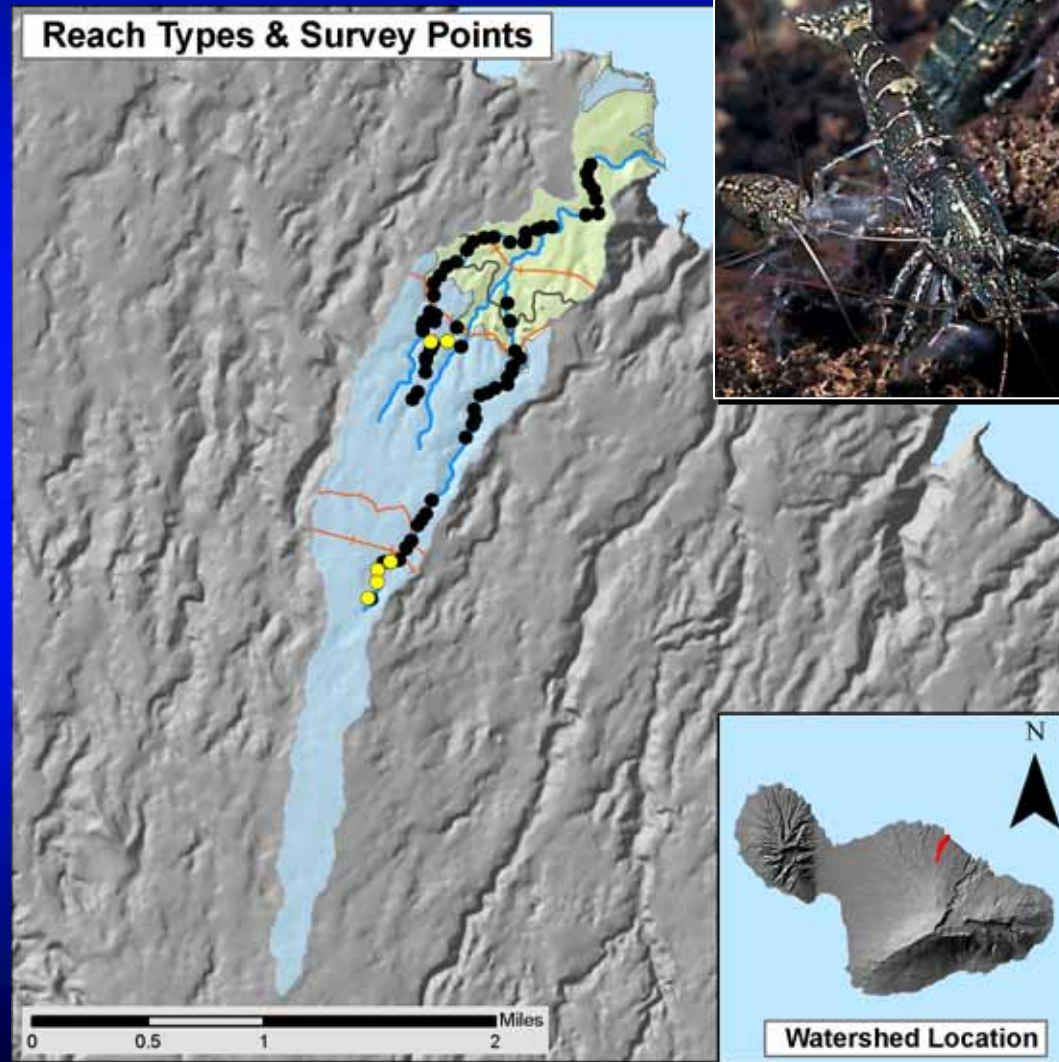
Hanehoi Stream

Fishes



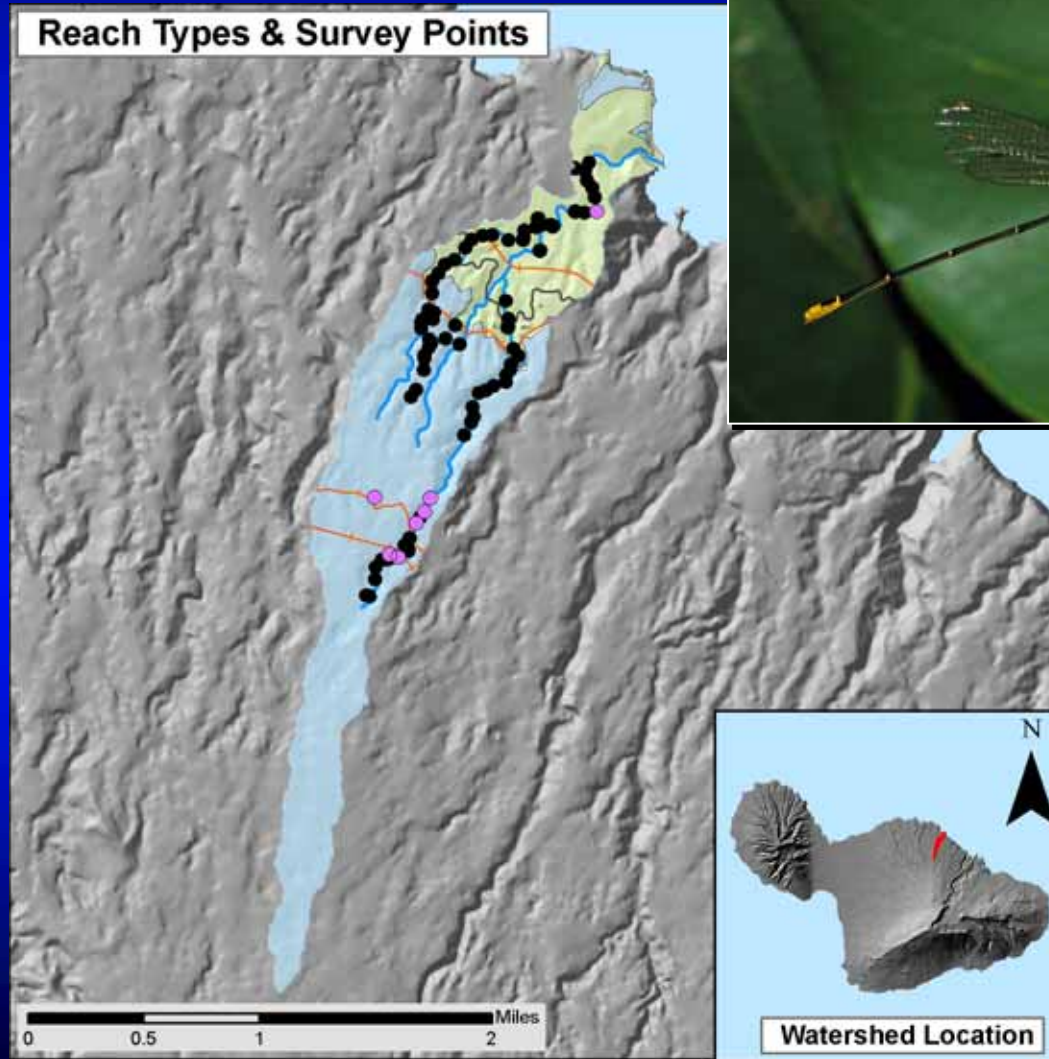
Hanehoi Stream

Crustaceans



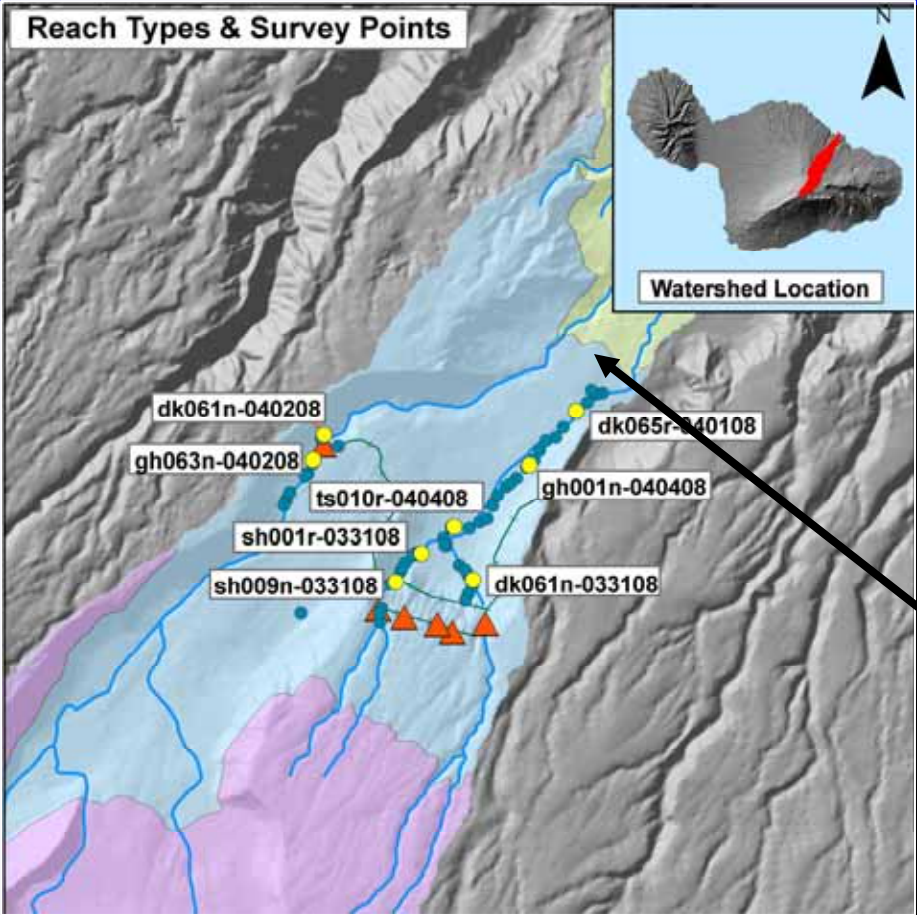
Hanehoi Stream

Stream Insects

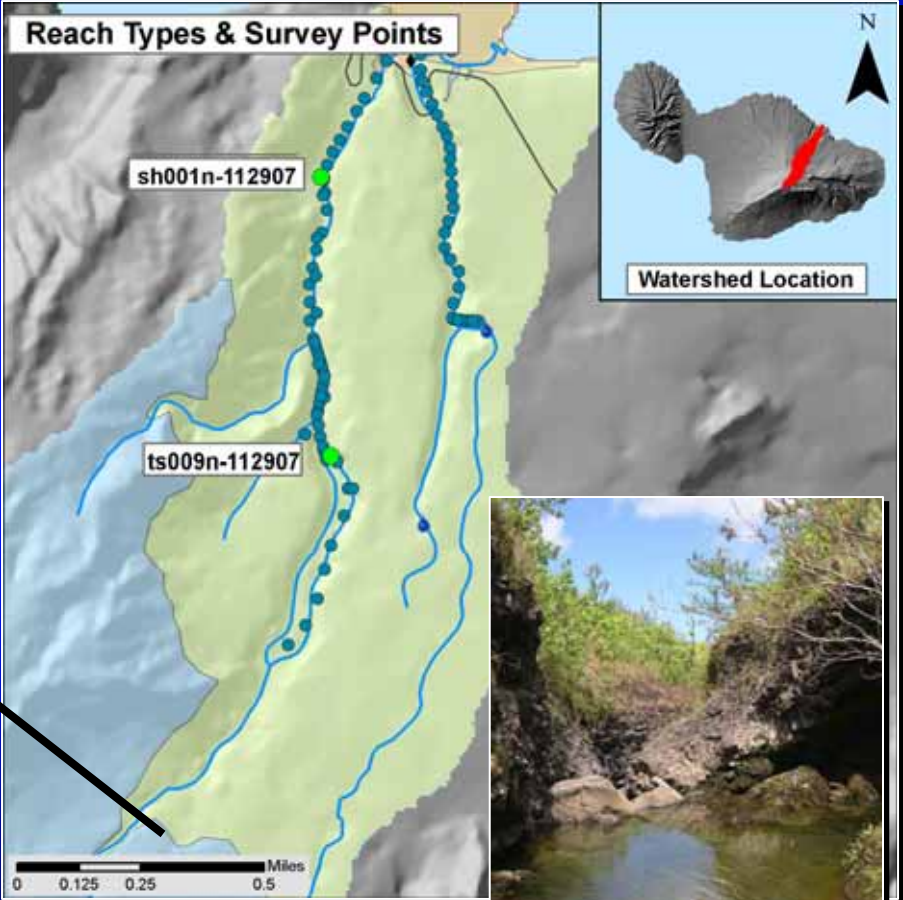


Piinaau Stream

Survey Sites



Upper catchment

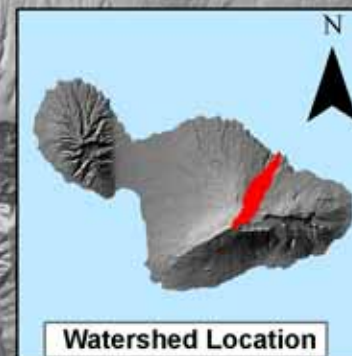
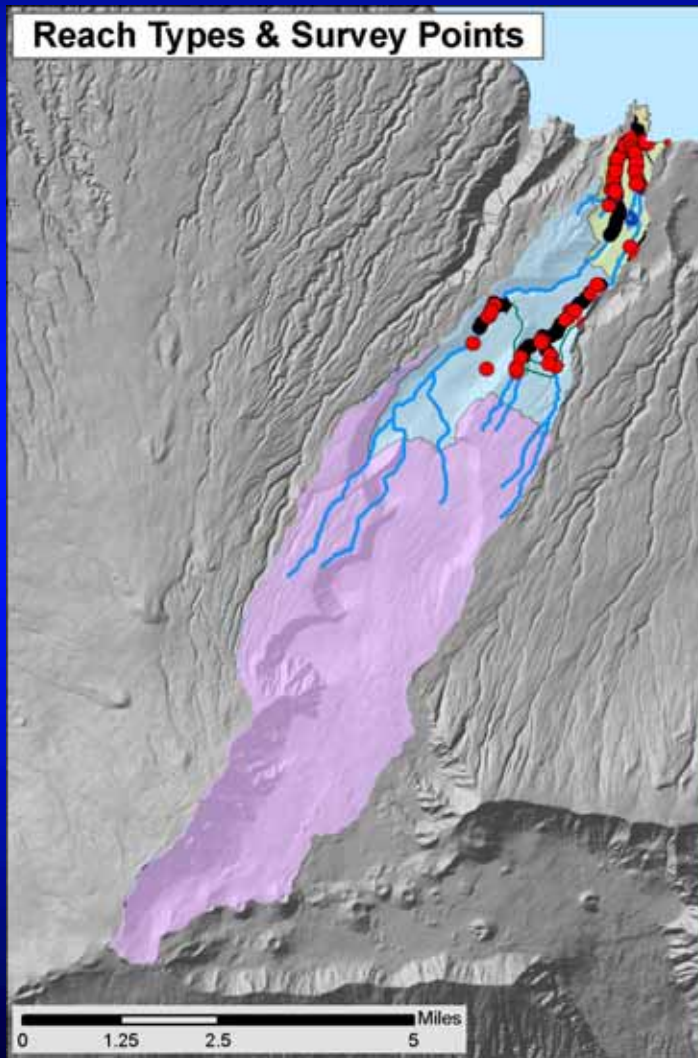


Lower catchment



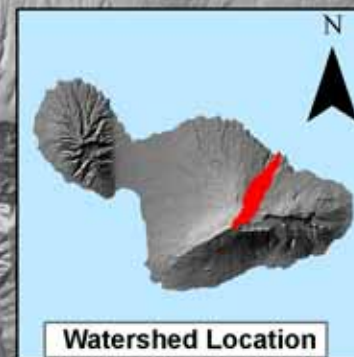
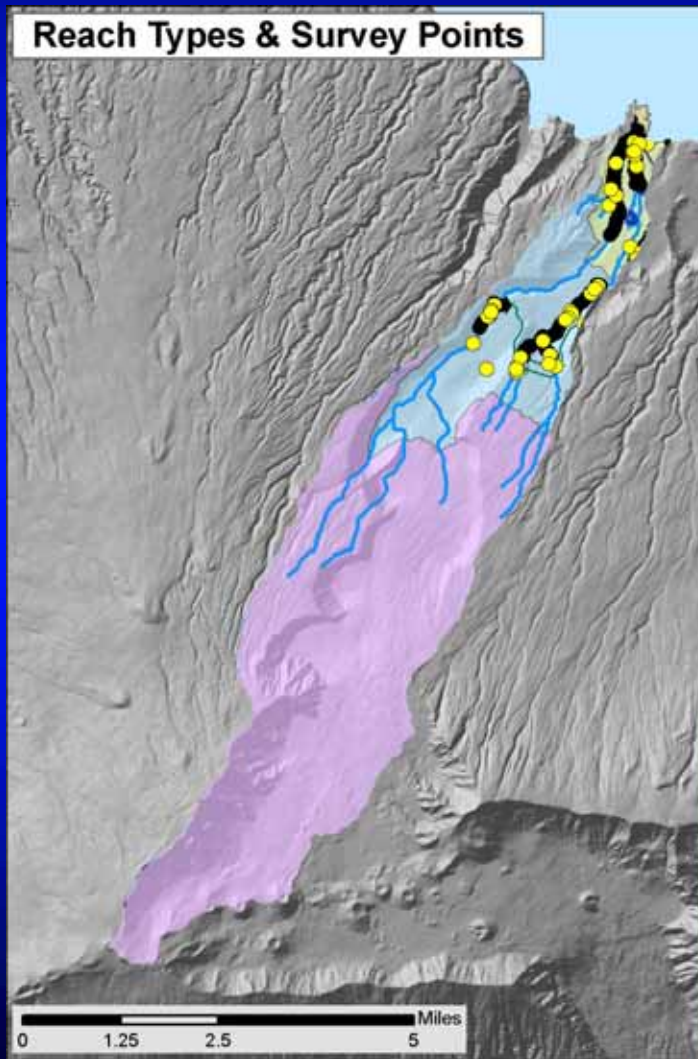
Piinaau Stream

Fishes



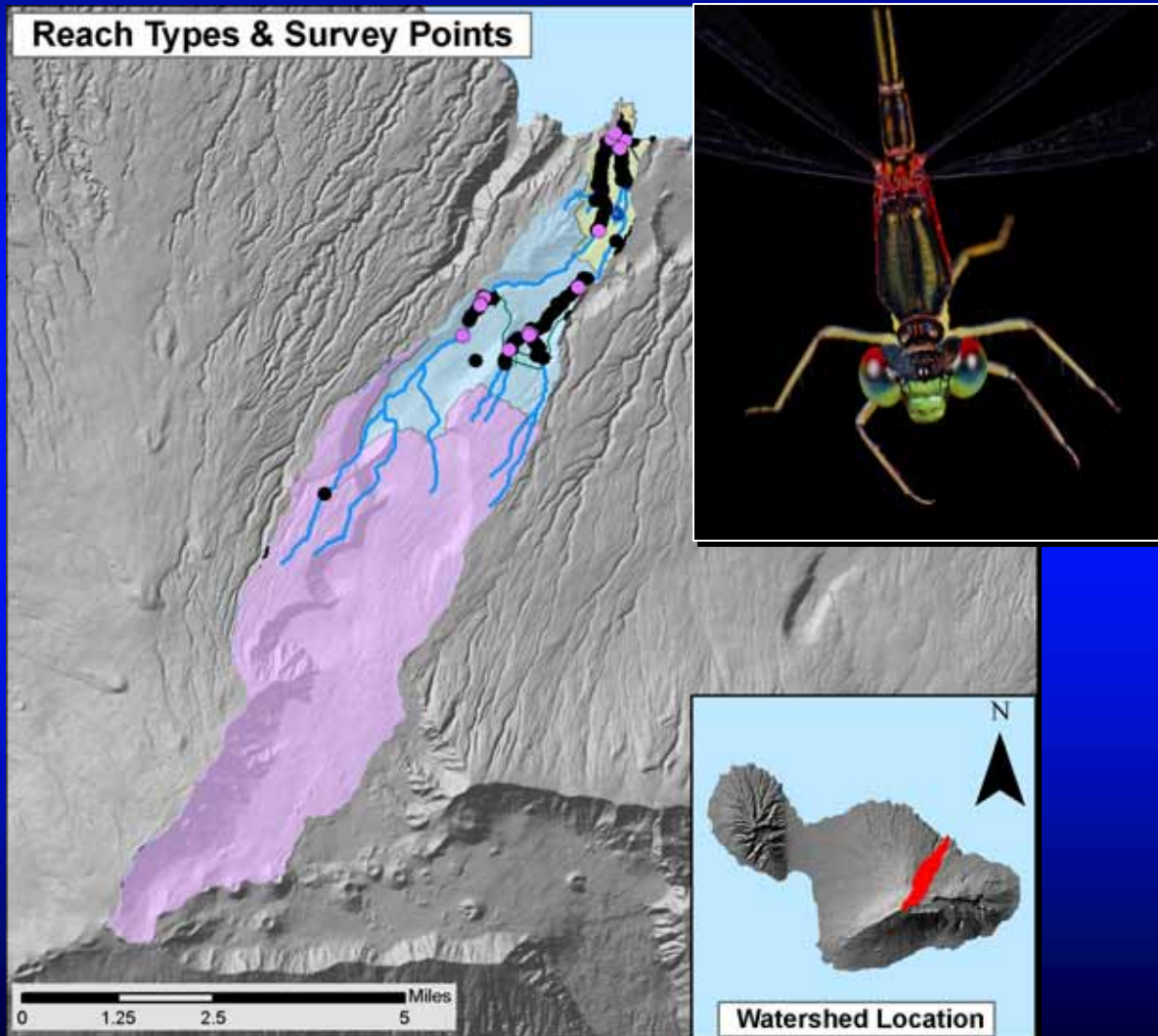
Piinaau Stream

Crustaceans



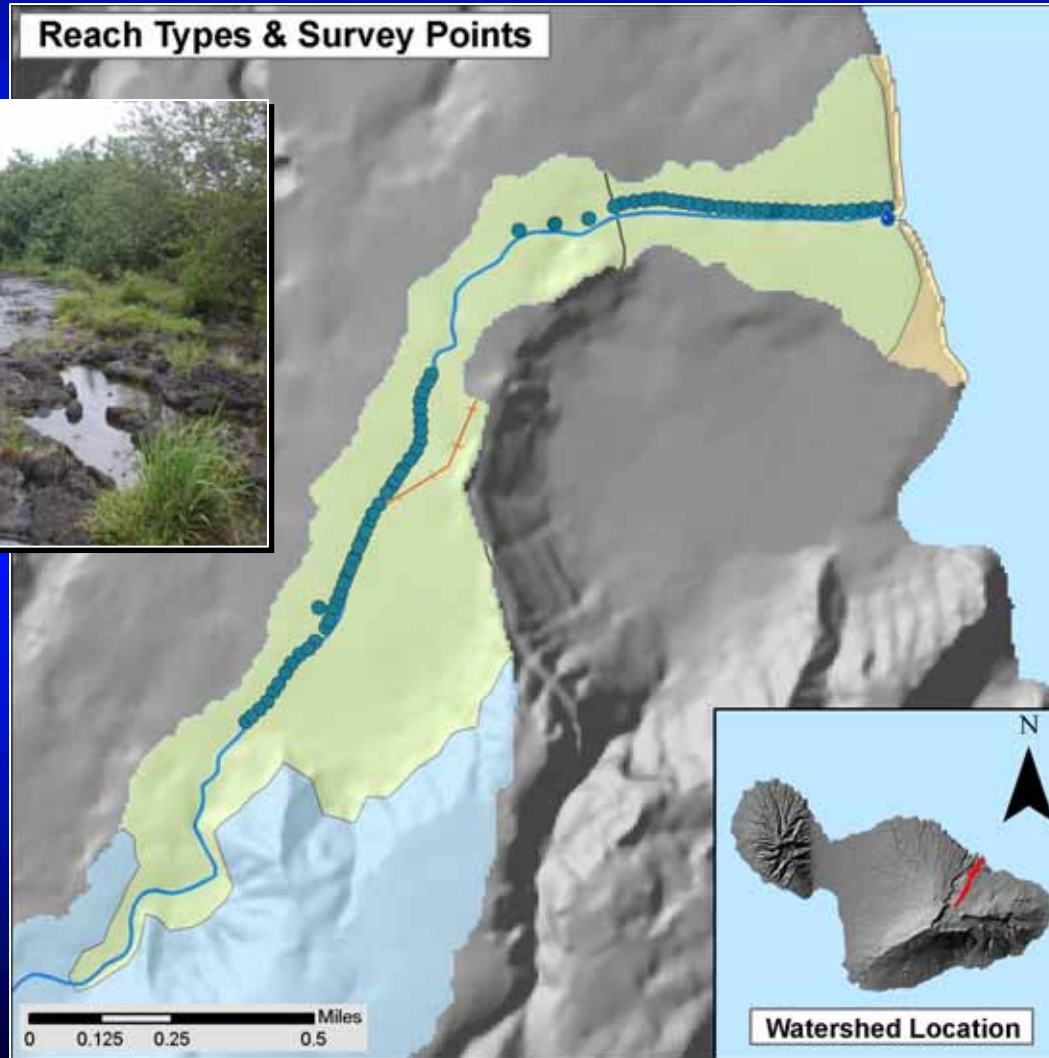
Piinaau Stream

Stream Insects



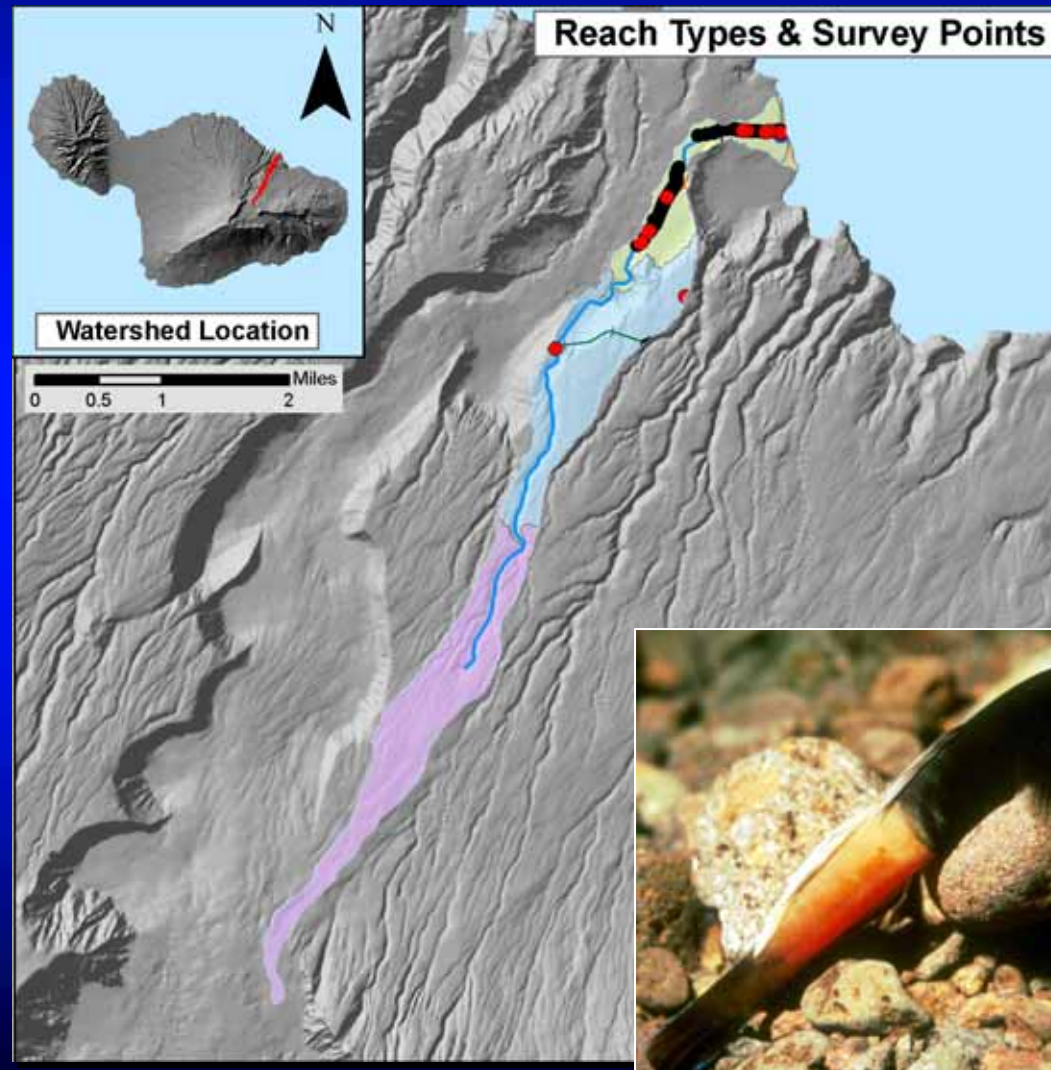
Waiokamilo Stream

Survey Sites



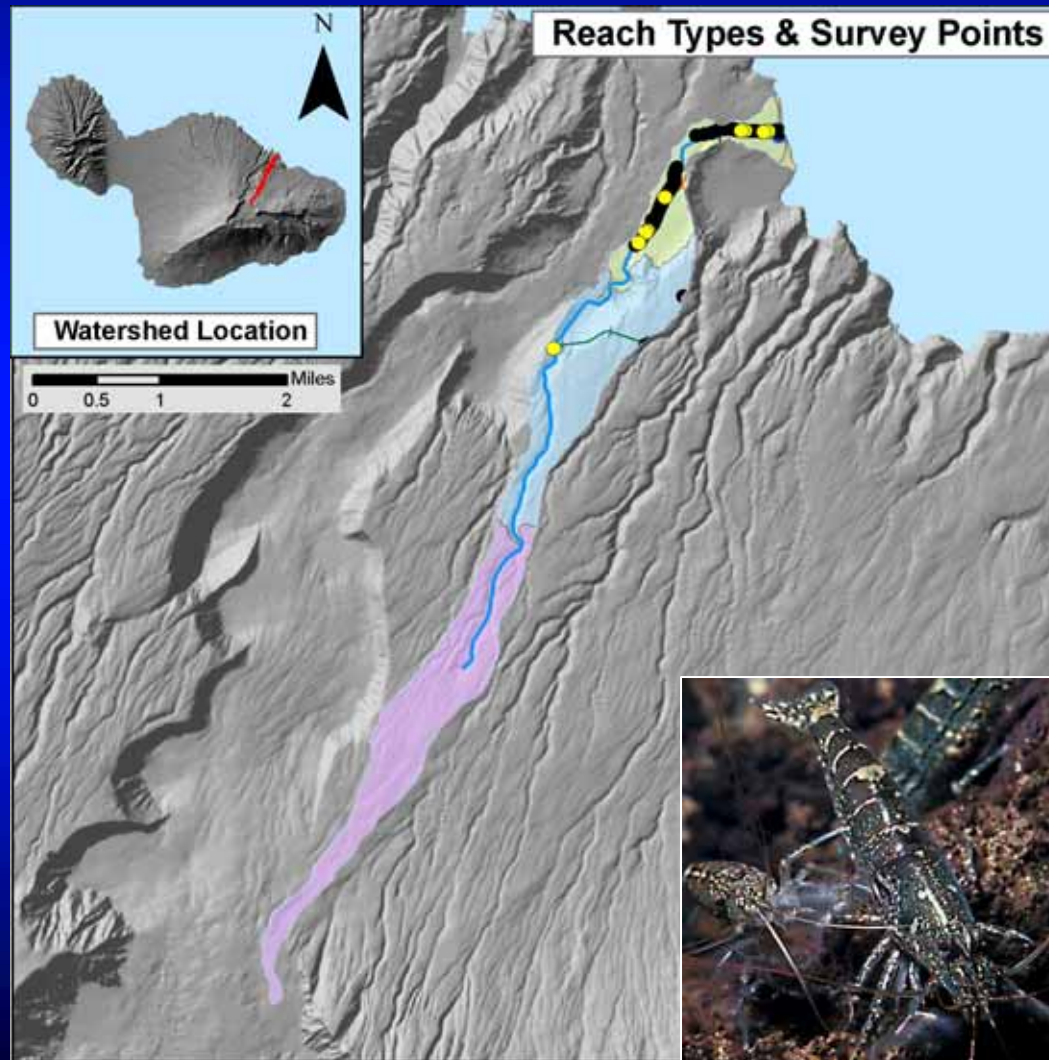
Waiokamilo Stream

Fishes



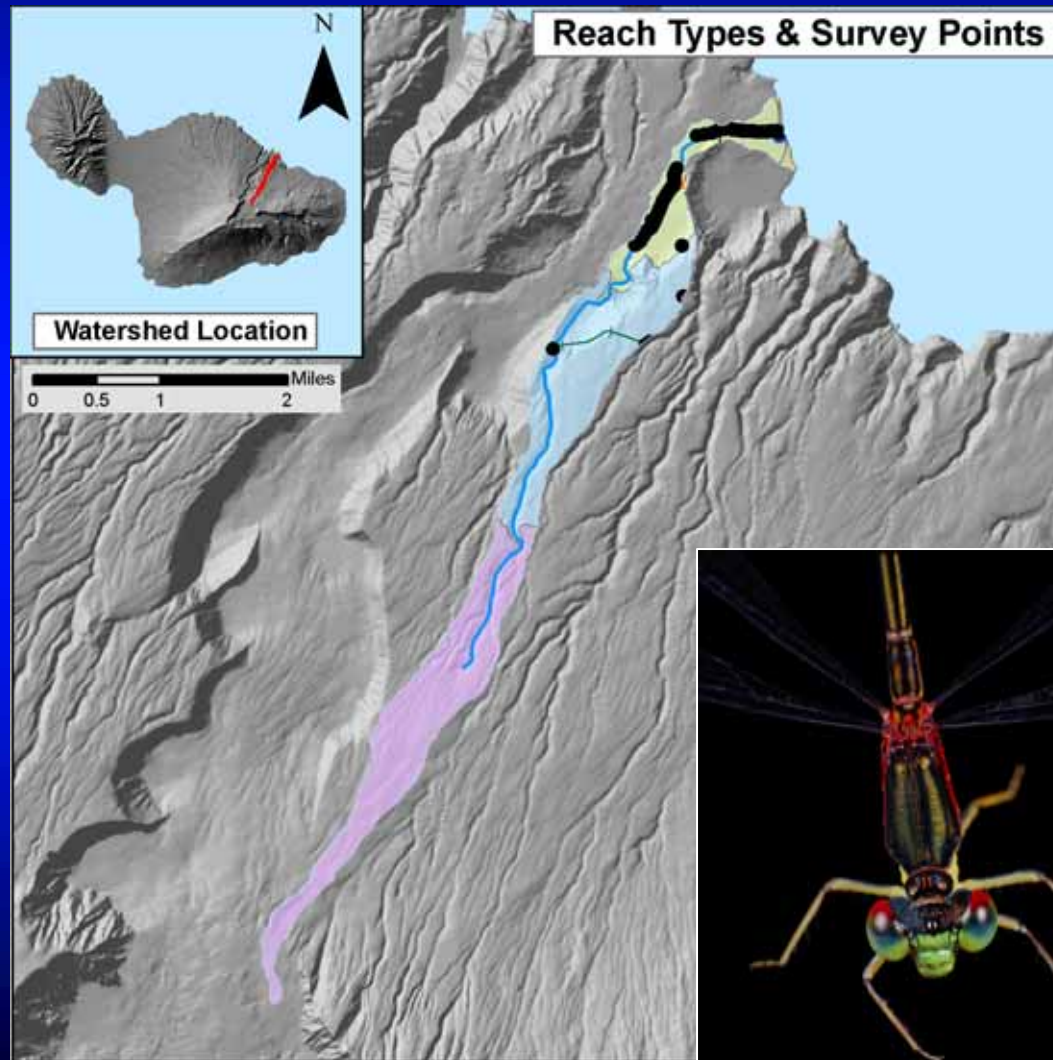
Waiokamilo Stream

Crustaceans



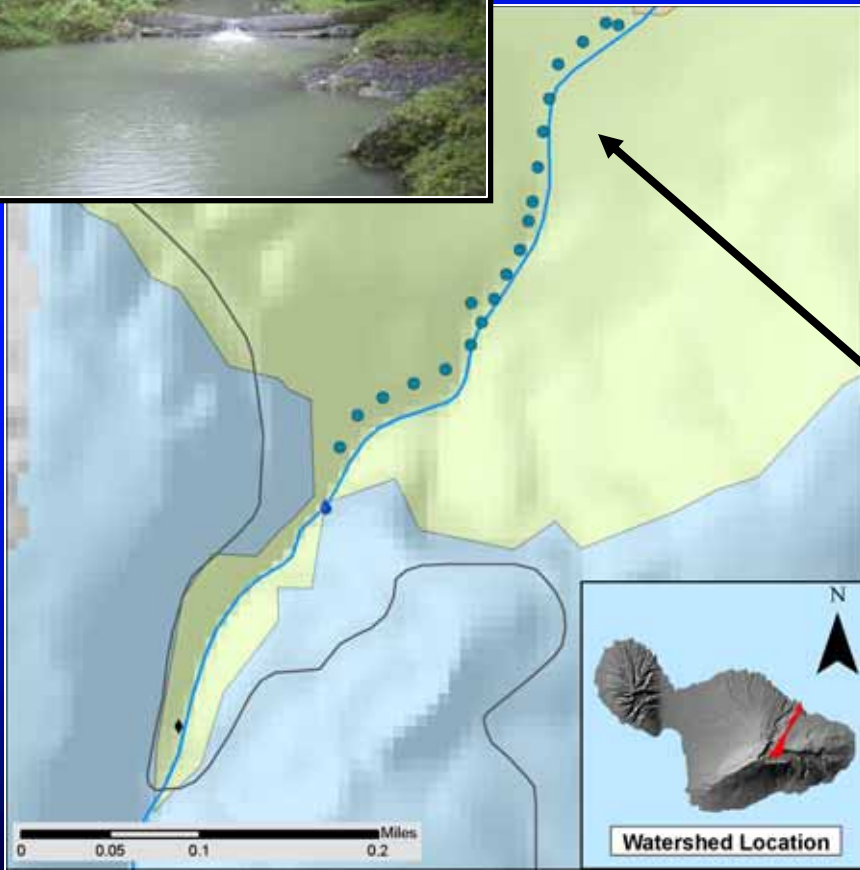
Waiokamilo Stream

Stream Insects

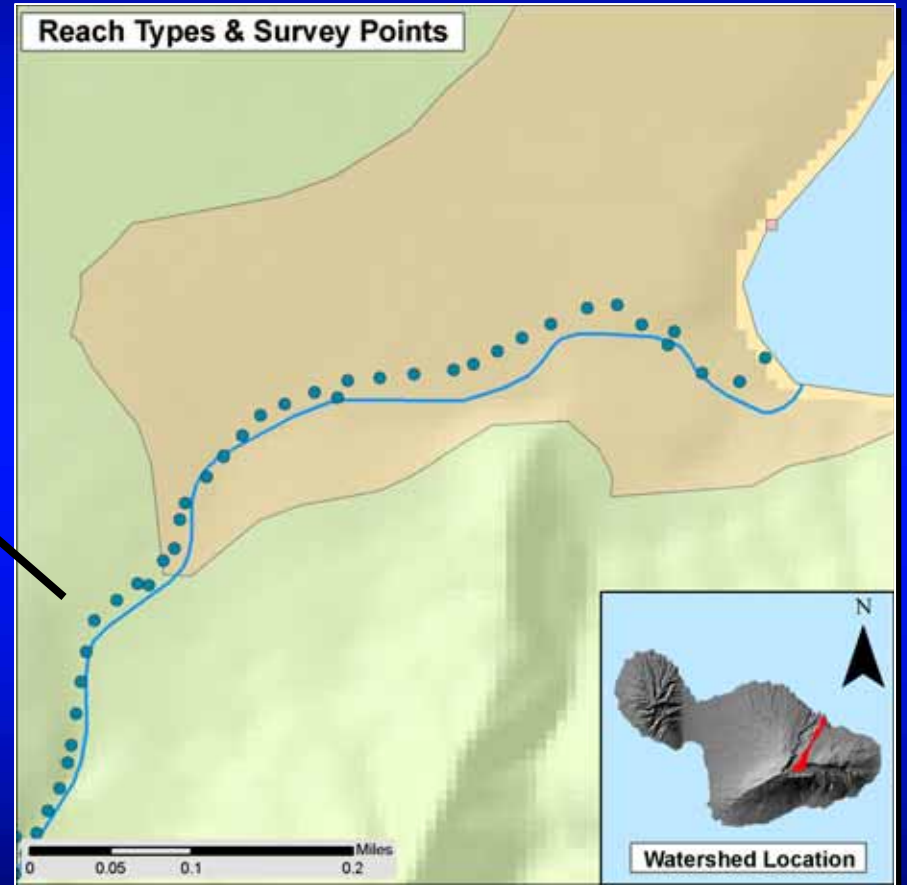


Wailuanui Stream

Survey Sites



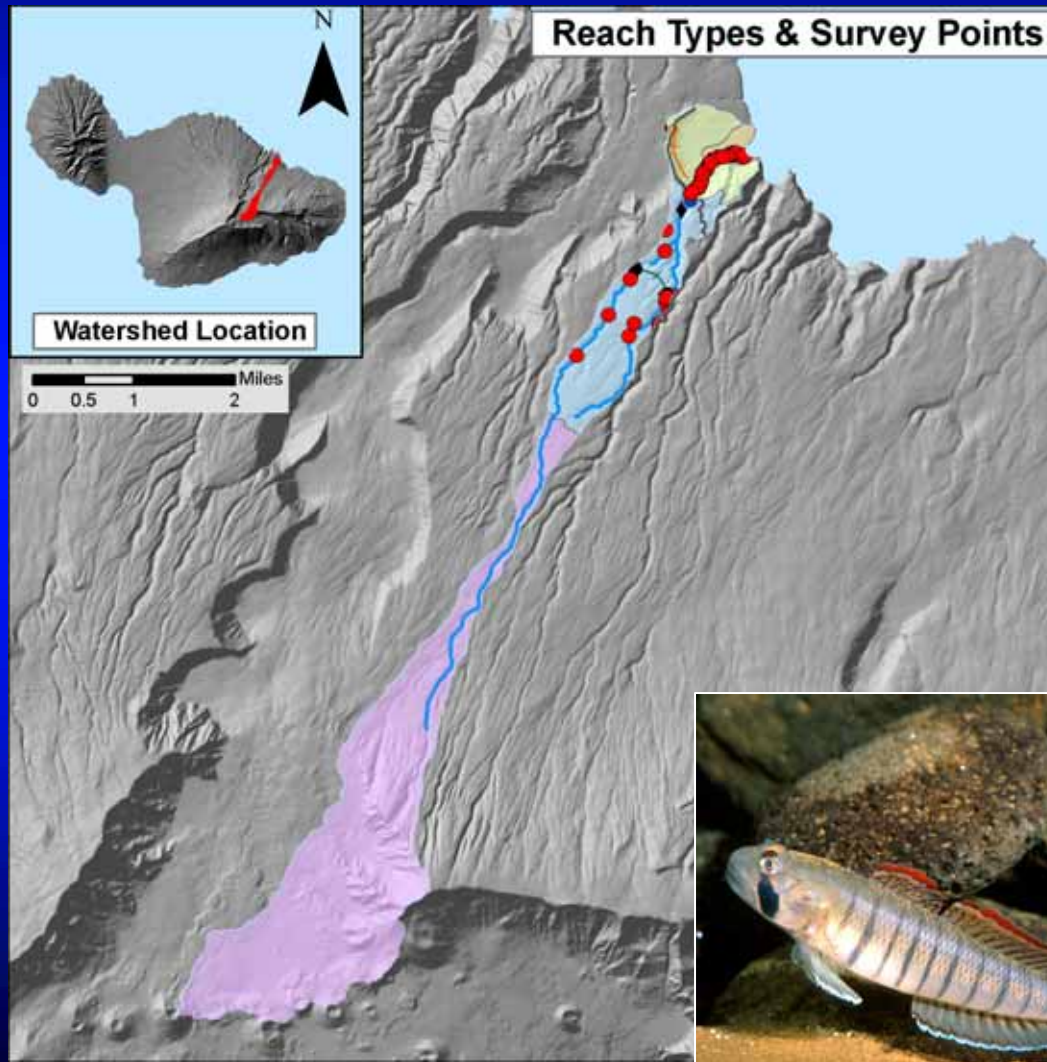
Upper catchment



Lower catchment

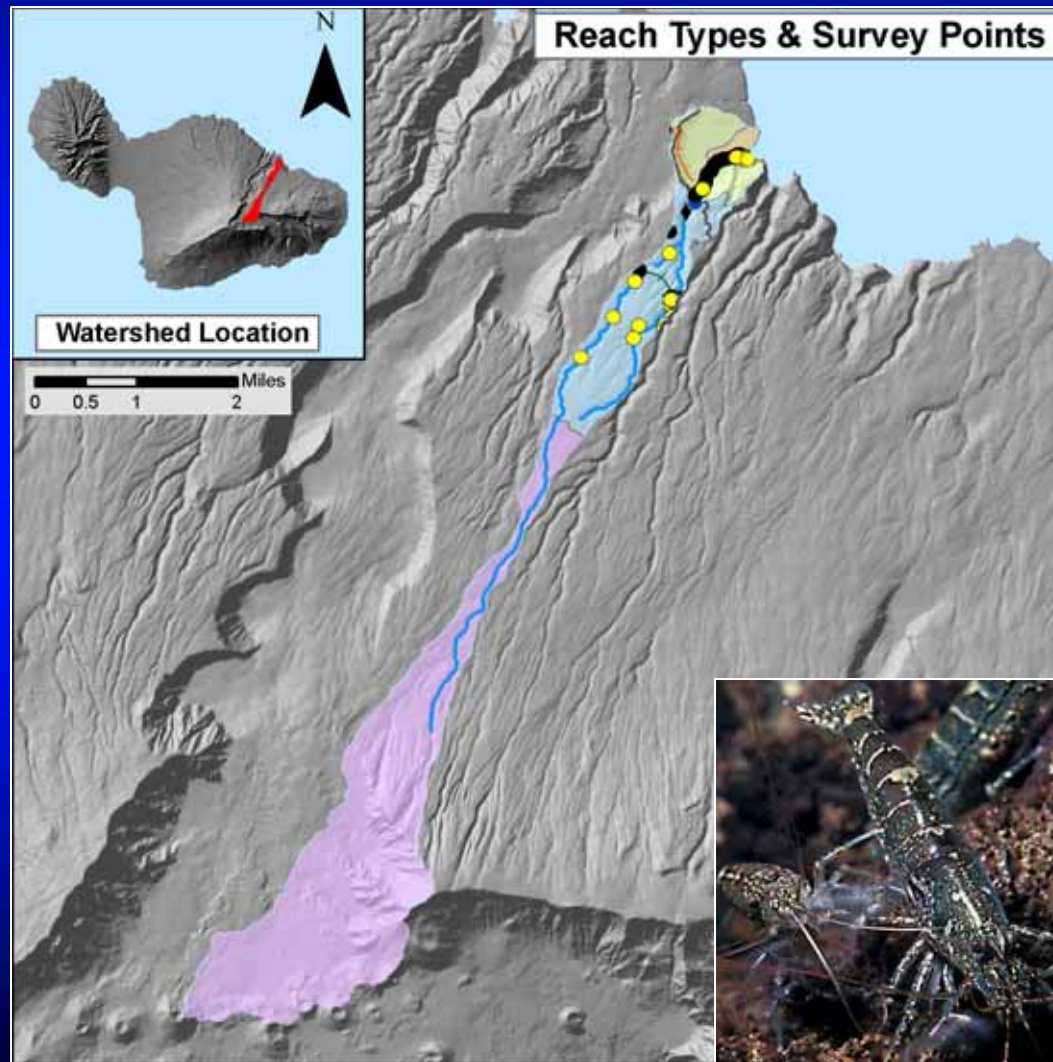
Wailuanui Stream

Fishes



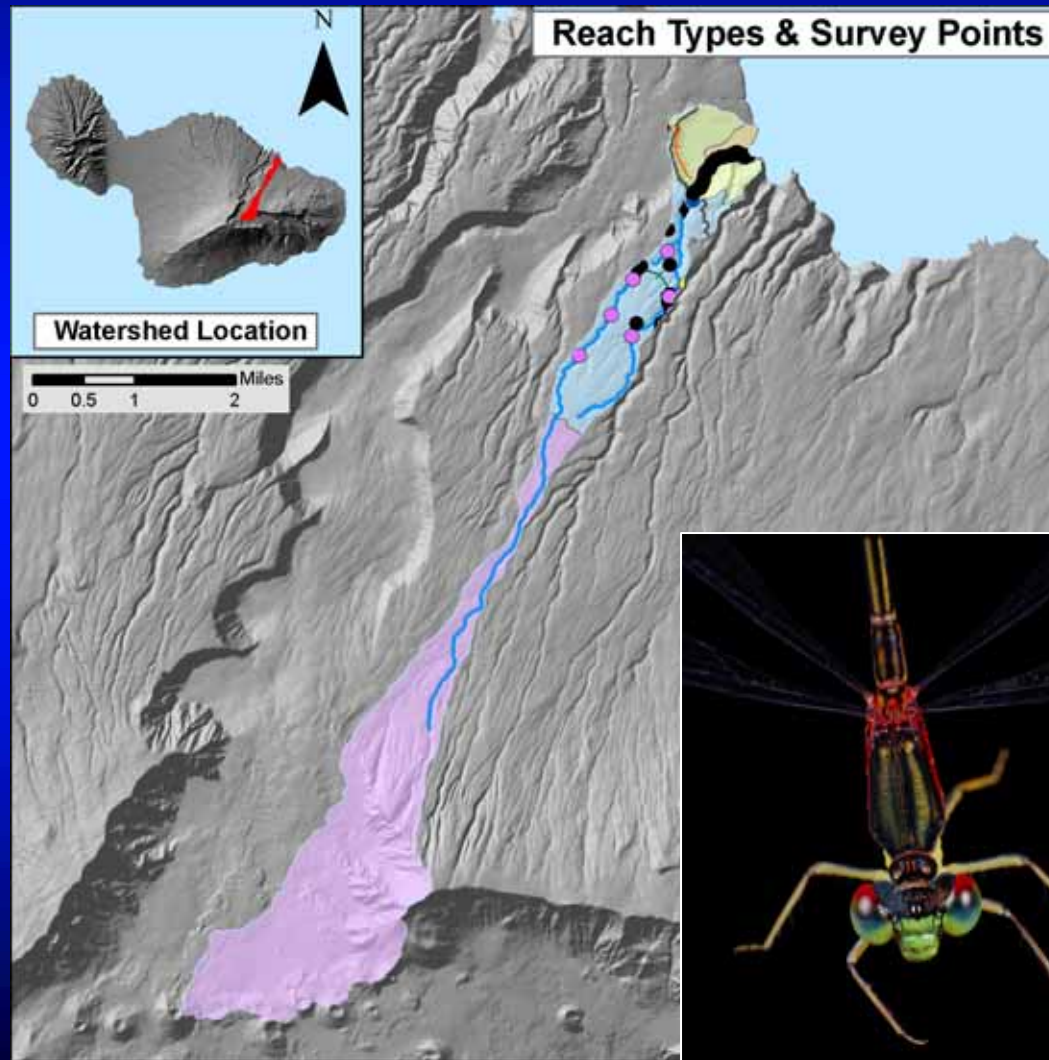
Wailuanui Stream

Crustaceans



Wailuanui Stream

Stream Insects



RESULTS



NATIVE FRESHWATER FISHES

Are present in 4 of the 5 systems surveyed
Found only in the extreme terminal reaches

Lack of sufficient flow precludes upstream migration

Honopou Stream

4 native fishes present; 2 invasive species also occur

Hanehoi Stream

No native fishes present; 2 invasive species occur

Piinaau Stream

6 native fishes present; 1 invasive species also occurs

Waiokamilo Stream

1 native fish present; 5 invasive species also occur

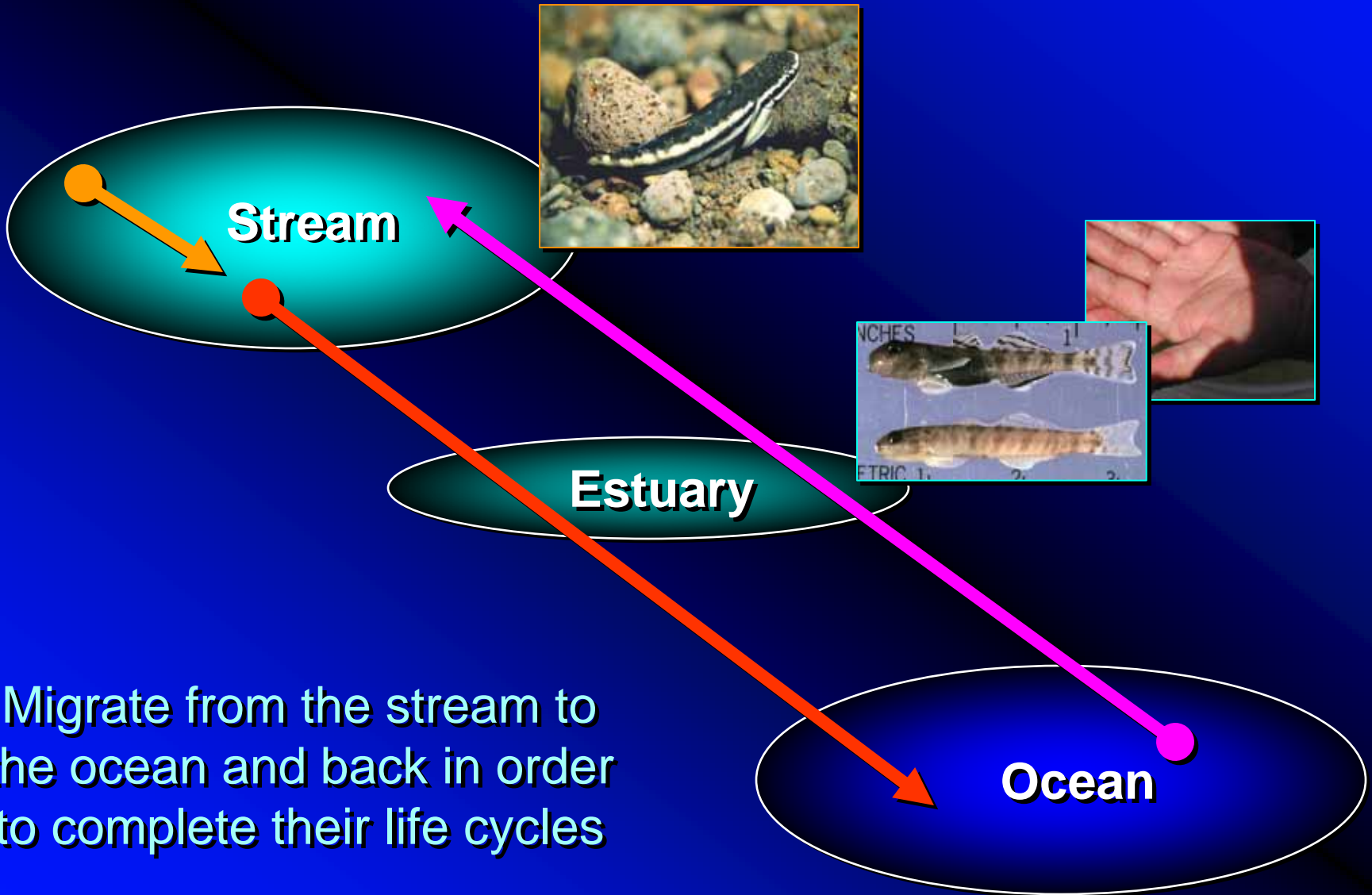
Wailuanui Stream

5 native fishes present; no invasive species detected

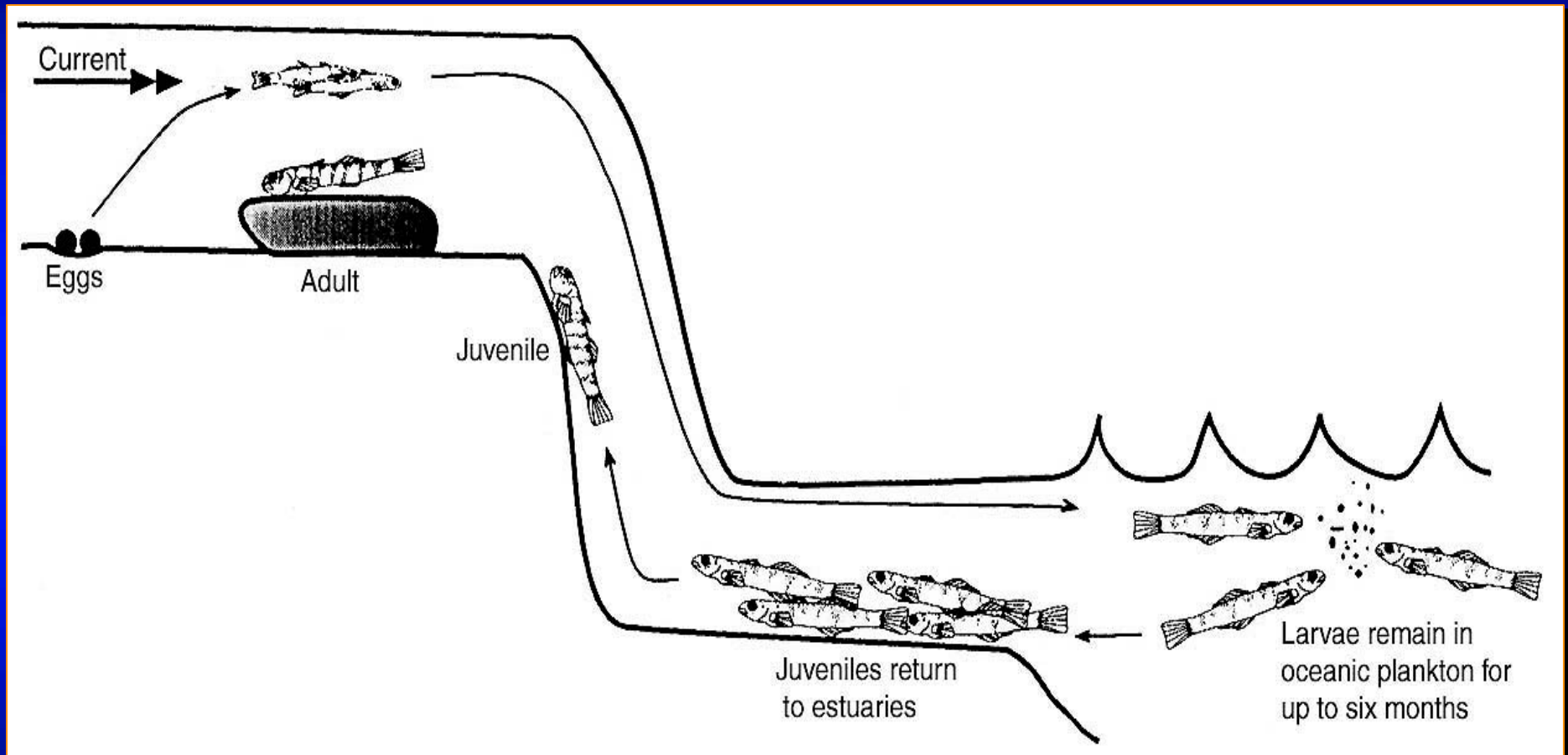
Native Hawaiian Stream Fishes



ALL NATIVE STREAM FISHES ARE *AMPHIDROMOUS*



Amphidromous Life Cycle



From Schoenfus, 2002

RESULTS

NATIVE FRESHWATER CRUSTACEANS

Are found in all 5 systems surveyed



Atyoida bisulcata and *Macrobracium grandimanus*

Honopou Stream

2 native species present; 1 invasive species occurs

Hanehoi Stream

1 native species present; 2 invasive species occur

Piinaau Stream

2 native species present; 1 invasive species occurs

Waiokamilo Stream

1 native species present; 2 invasive species occur

Wailuanui Stream

2 native species present; 2 invasive species occur

RESULTS



NATIVE FRESHWATER MOLLUSCS

Are absent in 3 of the 5 systems surveyed

Lack of sufficient flow inhibits recruitment from marine environments

Honopou Stream

No native molluscs present; 1 invasive species occurs

Hanehoi Stream

No native molluscs present; 2 invasive species occur

Piinaau Stream

3 native molluscs present; 7 invasive species occur

Waiokamilo Stream

No native molluscs present; 2 invasive species occur

Wailuanui Stream

2 native molluscs present; 2 invasive species occur

Native stream species have distinct distributions



Headwater Reach

Midreach



Terminal Reach

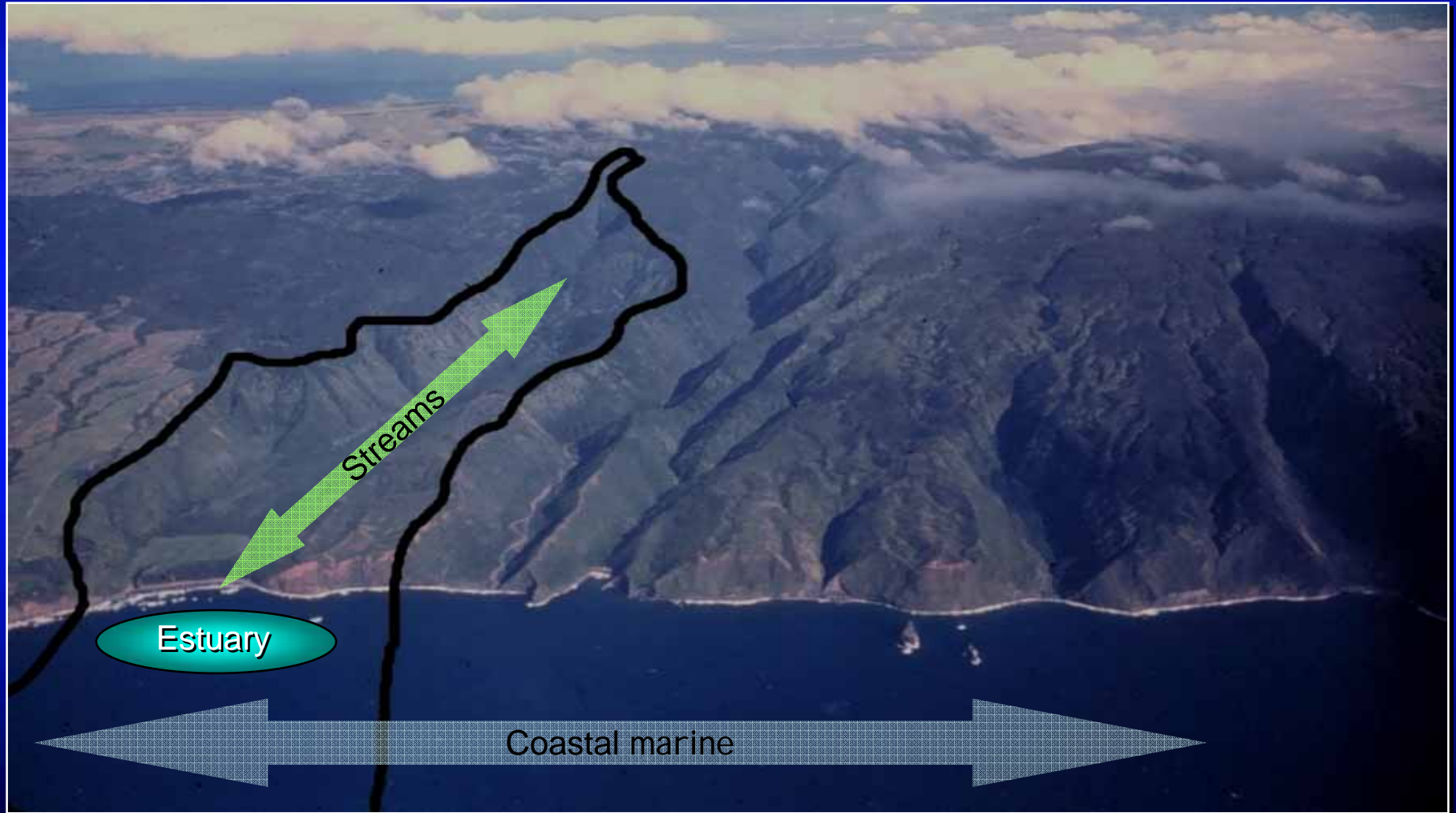


Native fishes and macroinvertebrates

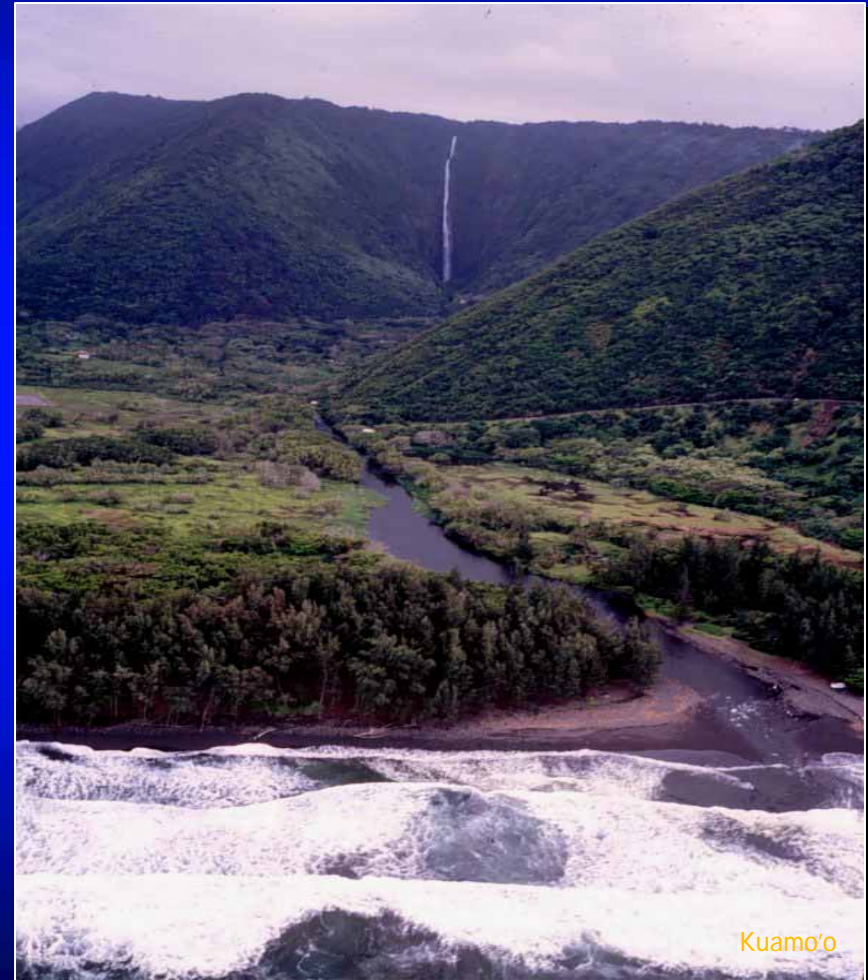
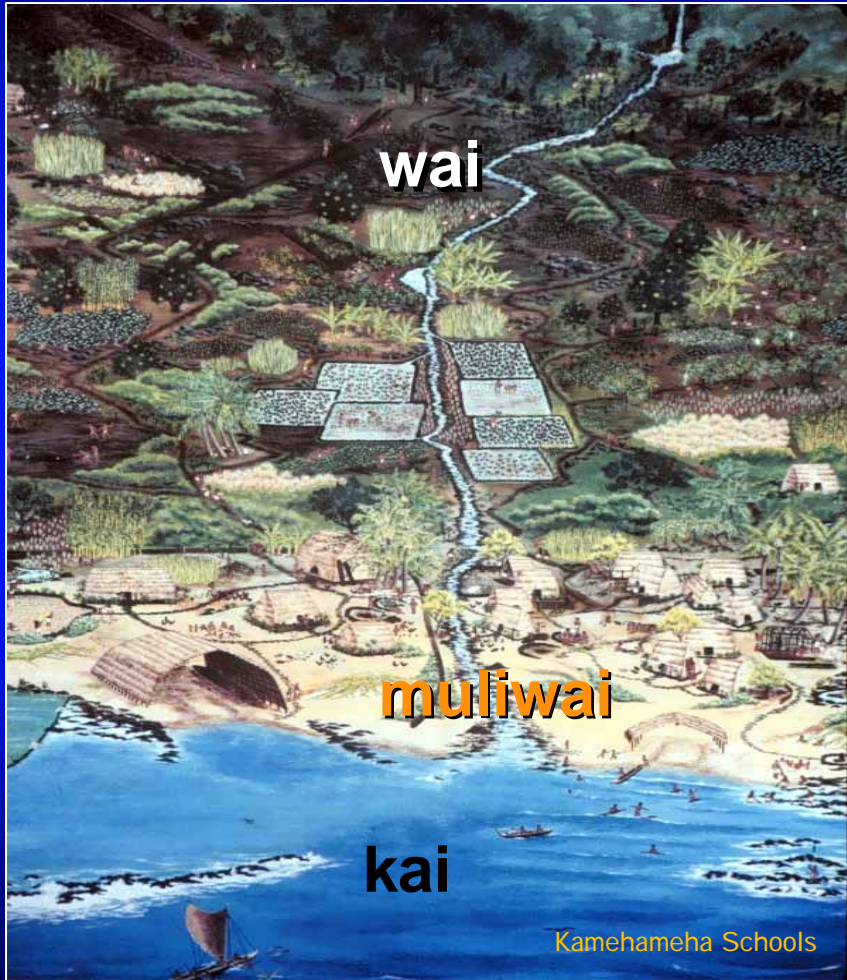
require stream flow to migrate between adult and larval habitats



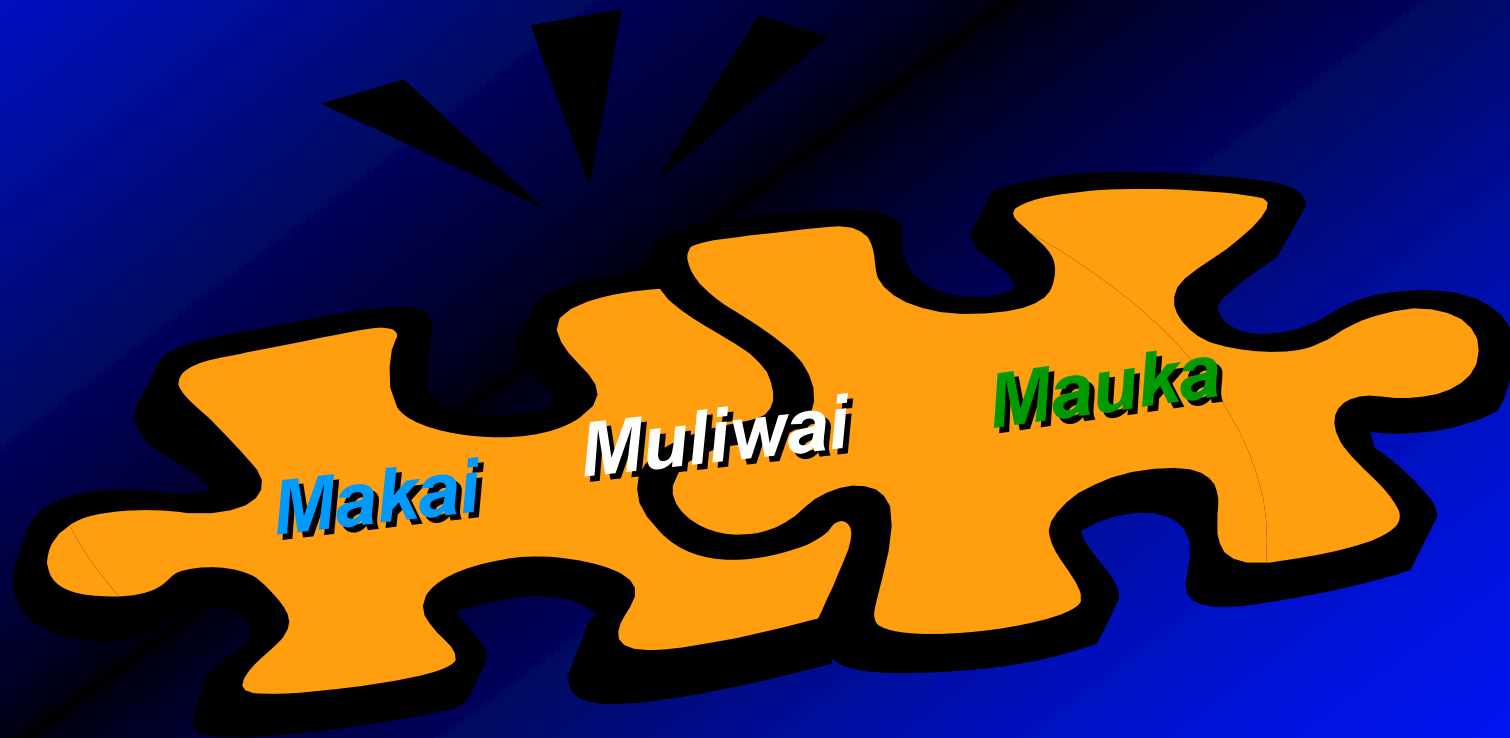
...every drop of water is connected



Wai – Muliwai - Kai

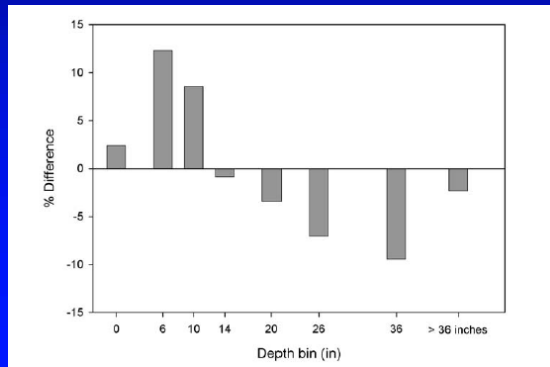


**A healthy native stream community
requires connectivity**

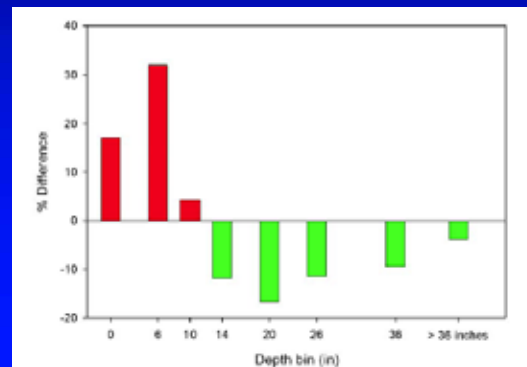


RESULTS

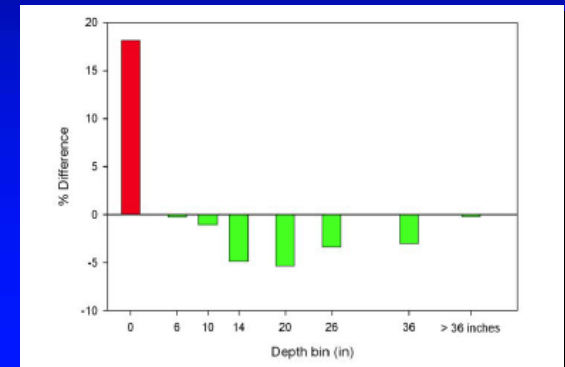
Depth Bin Analysis - Statewide Comparison



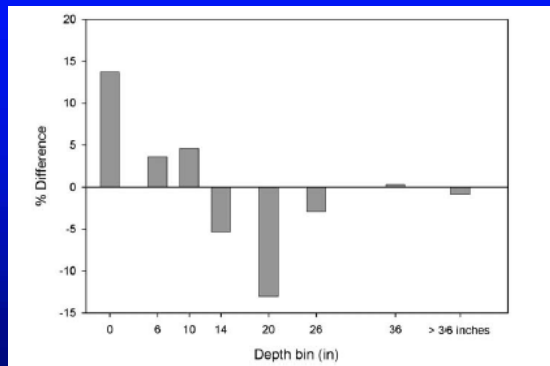
Honopou Stream



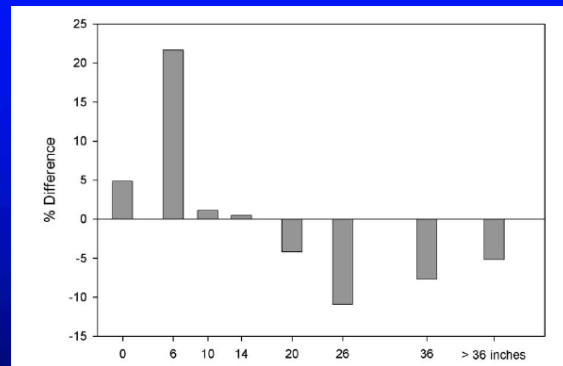
Hanehoi Stream



Piinaau Stream



Waiokamilo Stream

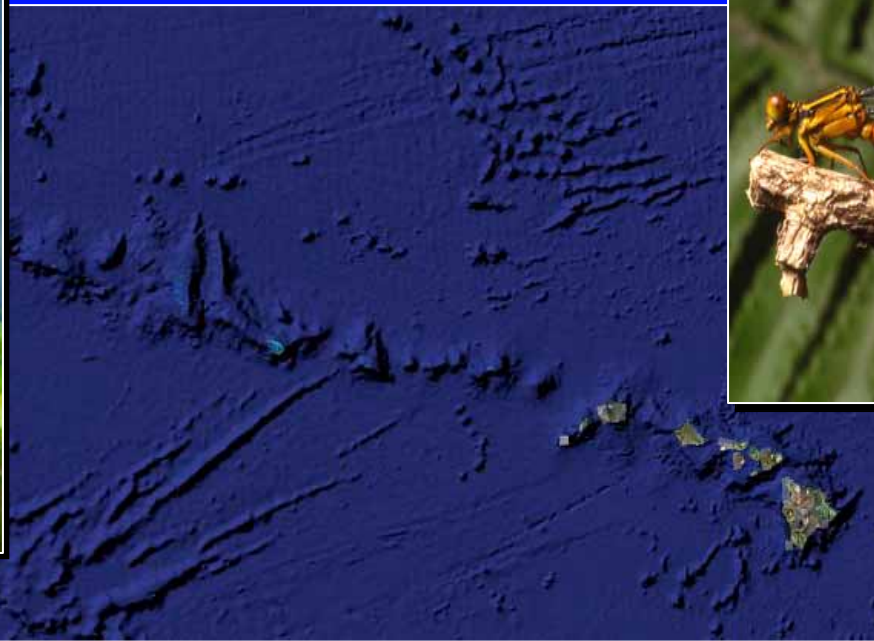


Wailuanui Stream

Compared to streams statewide, all streams show deficits for percent frequency of bins deeper than 14 inches, and excess frequency of shallow bins

AQUATIC INSECTS

Are the most speciose and diverse group
of native freshwater organisms
in the Hawaiian Islands



Hawaiian Freshwater Biota

Native Amphibians	0	
Introduced Amphibians		5
Native Reptiles	0	
Introduced Reptiles (Turtles)	3	
Native Fish Species	5	
Introduced Fish Species	60	
Native Crustaceans	2	
Introduced Crustaceans	3	
Native Aquatic Insects	200+	
Introduced Aquatic Insects	73+	
Native Mollusks	5-6	
Introduced Mollusks	9+	

RESULTS



NATIVE FRESHWATER INSECTS

Are present in systems surveyed to date

Data is limited or absent from 3 systems

Honopou Stream

20 native insects present*; 4 invasive species occur

Hanehoi Stream

11 native insects present*; 6 invasive species occur

Piinaau Stream

Limited surveys; 3 native damselflies present*

Waiokamilo Stream

No surveys yet conducted

Wailuanui Stream

Limited surveys; native damselflies are present

* = includes federal ESA listing candidate species

RESULTS

Native Stream Insects

Show decreasing richness downstream

Dewatered reaches supported greatly reduced native species assemblages

Native species representation (%) and richness versus elevation

<u>Sampling station</u>	<u>Elevation</u>	<u>% native species (total sp.)</u>	
Honopou Stream			
Station 1	90'	25	(4)
Station 2	150'	36	(11)
Station 3	430'	40	(15)
Station 4*	1200'	54	(13)**
Hanehoi Stream			
Station 1	290'	0	(3)
Station 2	385'	0	(1)
Station 3	405'	50	(2)
Station 4	530'	57	(7)
Station 5*	1220'	71	(14)**

* = above uppermost point of diversion on system

** = native damselflies present

RESULTS

Native Damselflies

Are absent in dewatered mid- and terminal reaches

Assemblage includes one federal ESA listing candidate



Megalagrion pacificum

Currently petitioned for Endangered status
by the U. S. Fish & Wildlife Service



Megalagrion nigrohamatum

Native species restricted to Maui and Molokai



CONCLUSIONS

Current diversions have converted perennial midreaches into the equivalent of intermittent streams

The few remnant pools are largely colonized by alien invasive species

Upstream migration of invasive species is inhibited by numerous waterfalls in the stream profiles

The ditch systems, however, provide lateral conduits for spread of invasives above these natural barriers

Invasive aquatic insects are able to fly in the adult stage, and thus disperse via alternate pathways

CONCLUSIONS

Recolonization potential for native species exists in all 5 streams

**Native fishes will recolonize
from the terminal reaches up**

**Insects will recolonize
from the headwater reaches down**

***Such recolonization can be
compromised by the presence
of aquatic invasive species***

Flow restoration considerations

**Use stream flows, not ditch flows
*This will mitigate the spread of
aquatic invasive species***



The true challenge



**Combining traditional knowledge and uses
with modern science
to find a new balance**



Thanks to:

East Maui Irrigation

The Taro Farmers of East Maui

**Commission on Water
Resource Management**



Division of Aquatic Resources State of Hawaii
Department of Land and Natural Resources