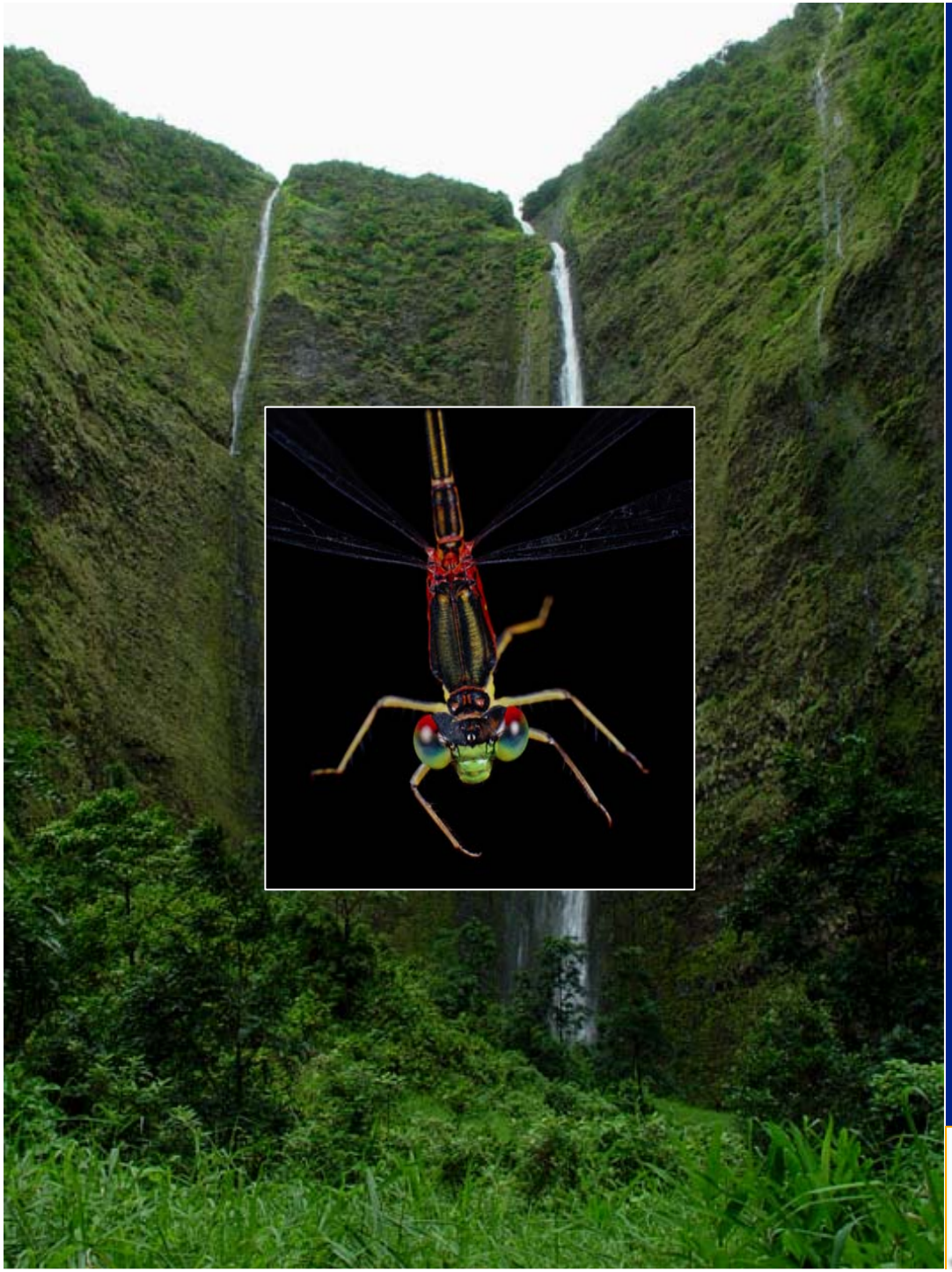

Integrating Aquatic Insect Data Into Hawaiian Stream Assessments

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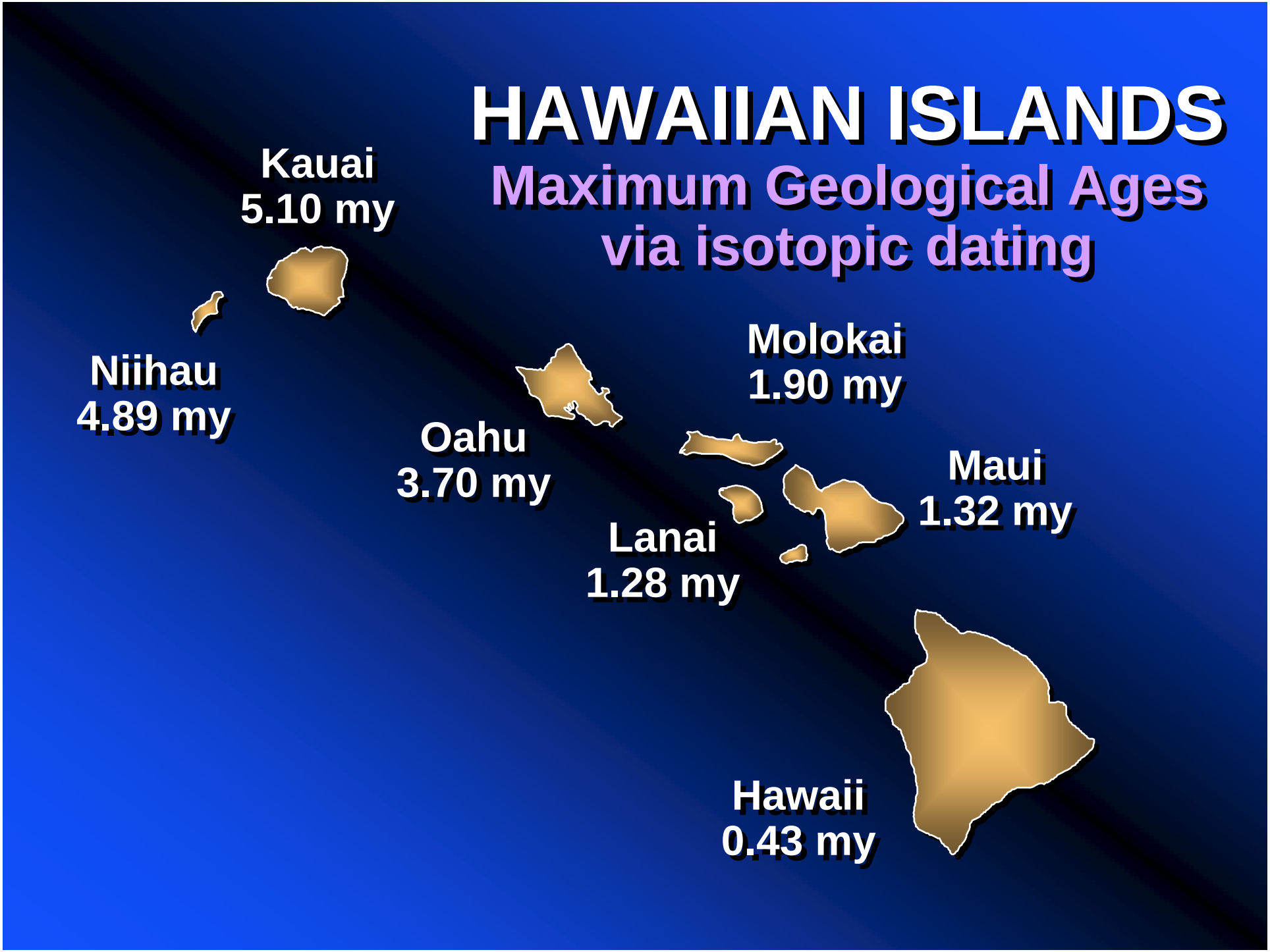
Division of Aquatic Resources
DLNR
State of Hawaii

Division of Aquatic Resources
Department of Land and Natural Resources
State of Hawai'i
"Insects for the Future"


HAWAII
Hawaiian Islands
is an isolated
hotspot archipelago

HAWAIIAN ISLANDS

Maximum Geological Ages via isotopic dating



DISHARMONIC FRESHWATER BIOTAS

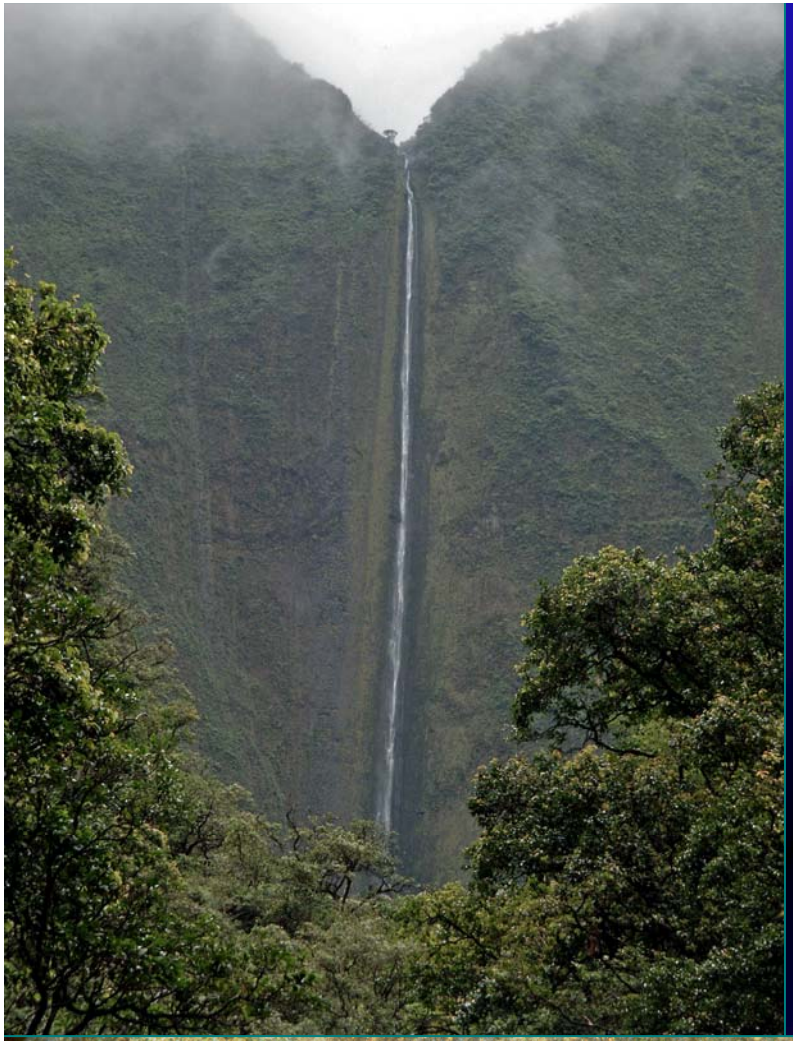
Limited freshwater fish assemblages lacking all primary freshwater groups

Freshwater insect assemblages lacking Trichoptera, Ephemeroptera, Plecoptera, Megaloptera

ATYPICAL COMMUNITY STRUCTURES

Freshwater fish assemblages dominated by diadromous gobioids

Freshwater insect assemblages dominated by Diptera, Odonata, Coleoptera and Heteroptera



Traditional Stream Surveys

Concentrate their activities on a limited assemblage of species

Generally target vertebrates and macroinvertebrates

These represent only 6% of the native biota

AQUATIC INSECTS

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

Megalagrion paludicola

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+	

Insects overall = 93% of the native + alien biota

ADVANTAGES OF USING AQUATIC INSECTS

High richness on a site and catchment basis

High beta diversity -
assemblages are reach-specific,
with turnover along altitudinal transects

Single island endemism

DISADVANTAGES OF USING AQUATIC INSECTS

Many species are very small and require specialized knowledge to collect

Identification in the field can be difficult; definitive ID often requires a microscope

Few specialists are available for these groups

Therefore, use of umbrella taxa, such as Odonata, may be the most practical approach

MEGALAGRION DAMSELFLIES

Are a particularly useful surrogate for the native aquatic insect biota in general

Megalagrion nigrohamatum

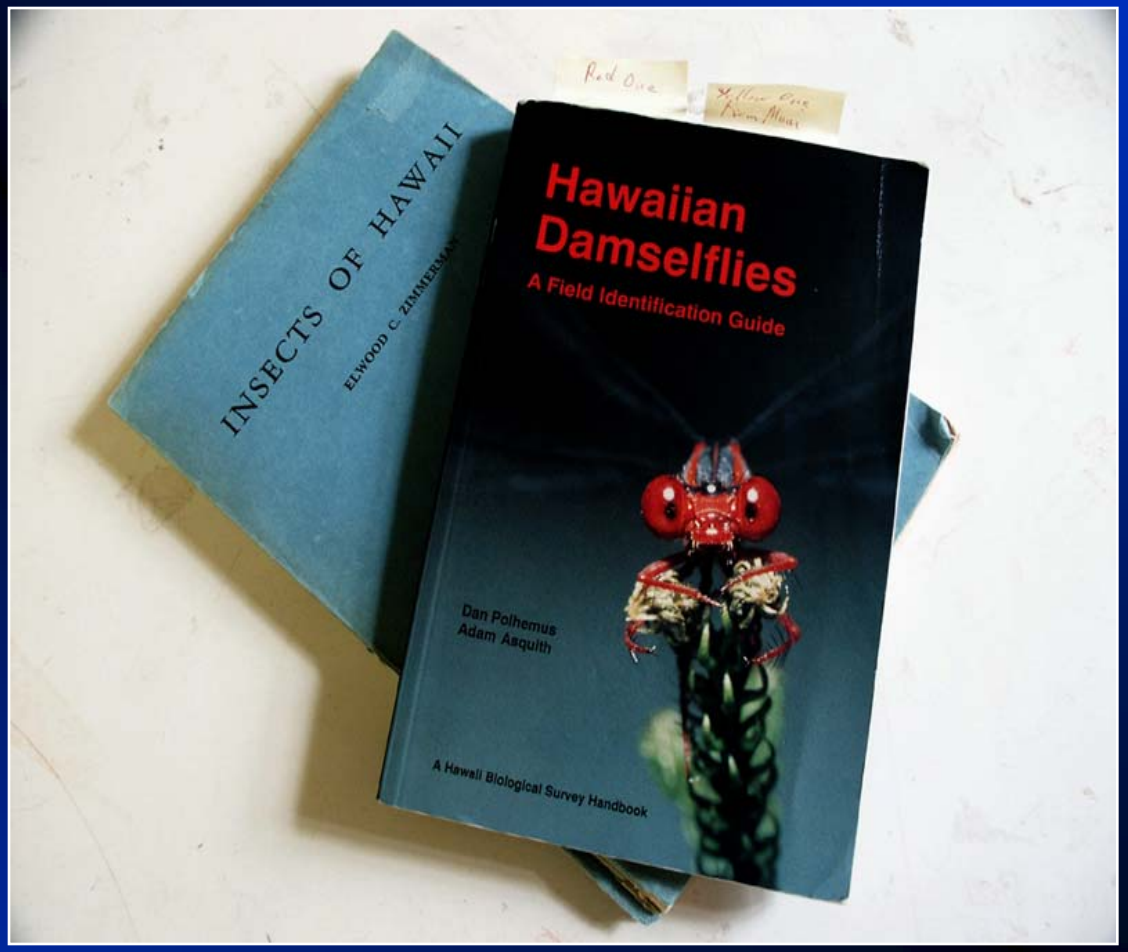
MEGALAGRION

Are well documented and easily identified

1996

HAWAIIAN DAMSELFLY HANDBOOK

Superceded previous treatment in Zimmerman's *Insects of Hawaii*



MEGALAGRION

Have well defined character systems in males…

MALE ABDOMINAL APPENDAGES

and in females…

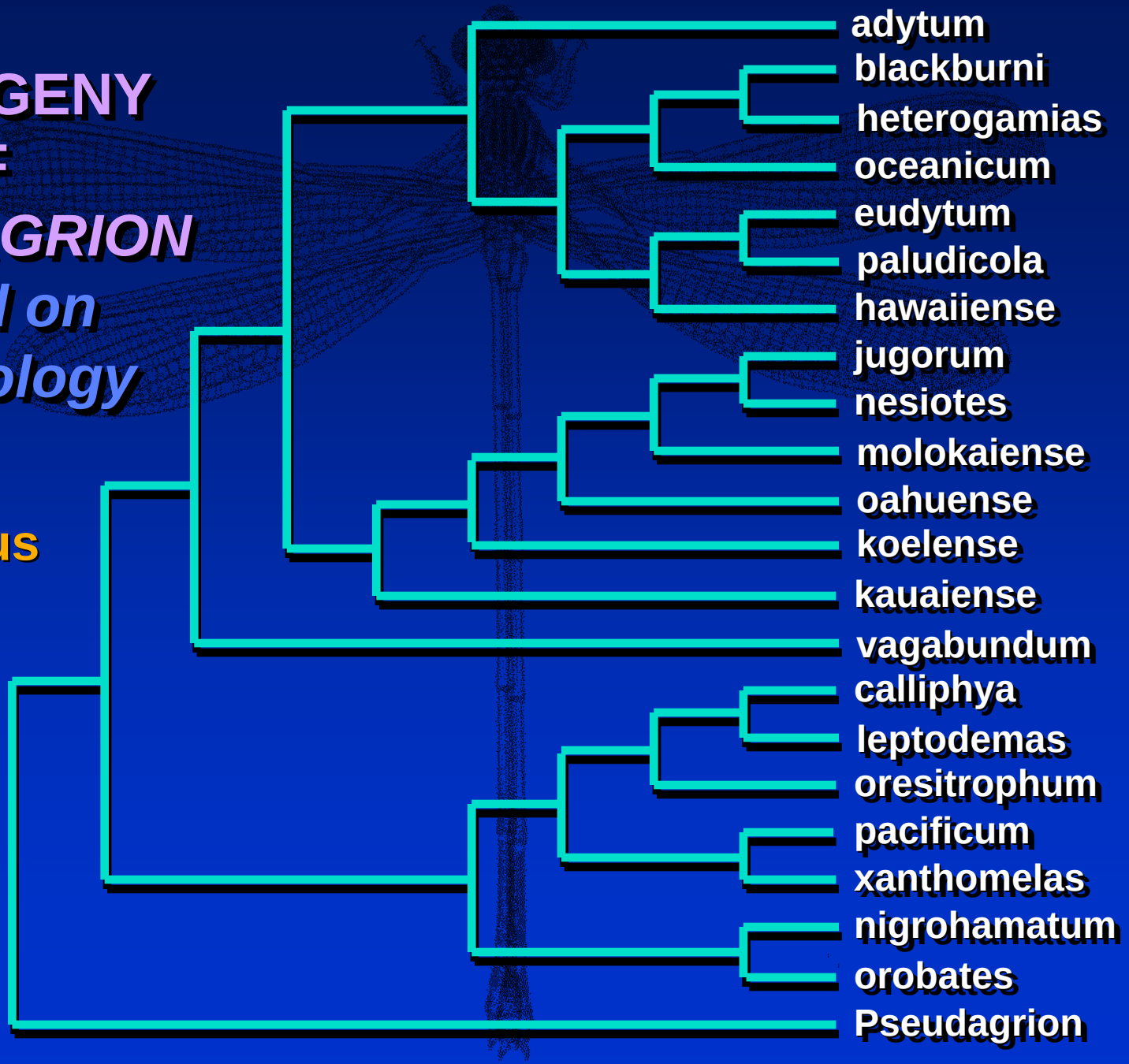


FEMALE MESOSTIGMAL LAMELLAE

MEGALAGRION HAS A SOLID PHYLOGENETIC FRAMEWORK

PHYLOGENY OF *MEGALAGRION* *based on Morphology*

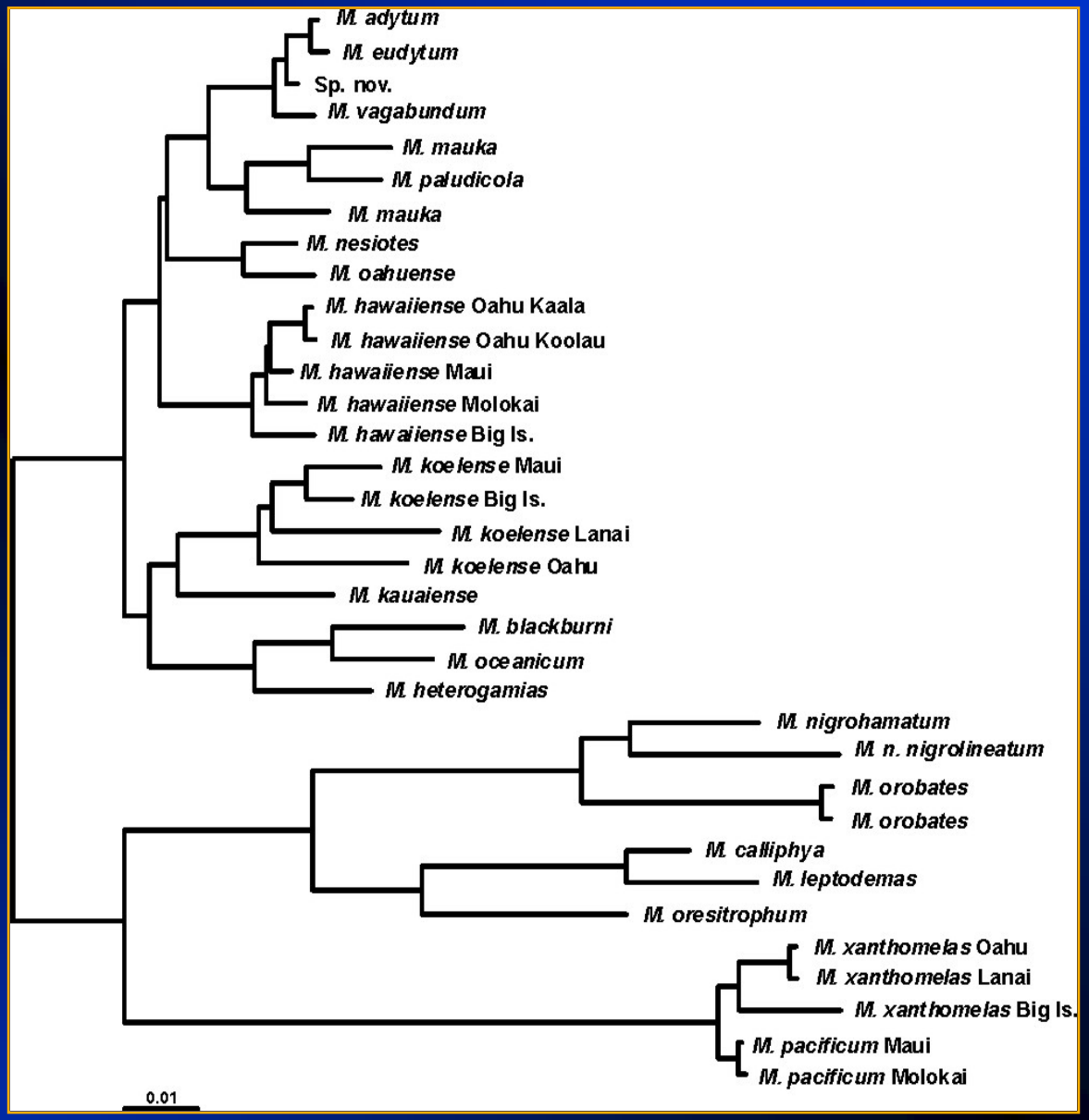
Polhemus 1996



MEGALAGRION ALSO HAS A MOLECULAR PHYLOGENETIC FRAMEWORK

PHYLOGENY OF *MEGALAGRION* *based on molecular* characters

Jordan, Simon & Polhemus 2003



This allows predictions of unknown ecological variables

BREEDING ECOLOGY

SLOW WATER

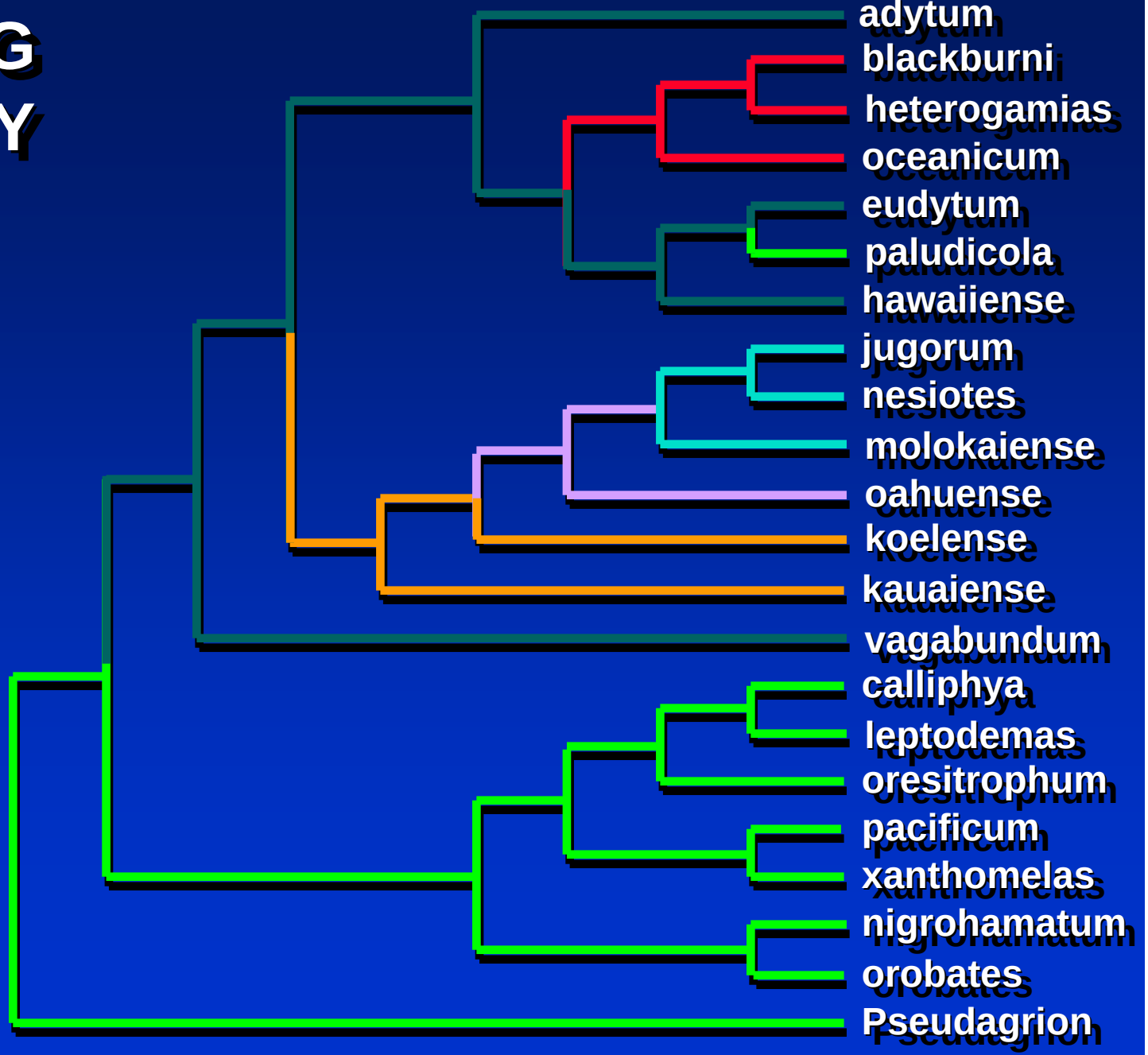
SEEPS

FAST WATER

PHYTOTELMATA

TERRESTRIAL

UNKNOWN



MEGALAGRION

Occupy a wide range of breeding habitats

POOLS

FAST WATER

SEEPS

PHYTOTELMATA

TERRESTRIAL

Current ESA Listing Status

FOUR CANDIDATE SPECIES
listing possible based on available data

***M. leptodemas* (Oahu)**

***M. nesiotes* (Maui)**

***M. oceanicum* (Oahu)**

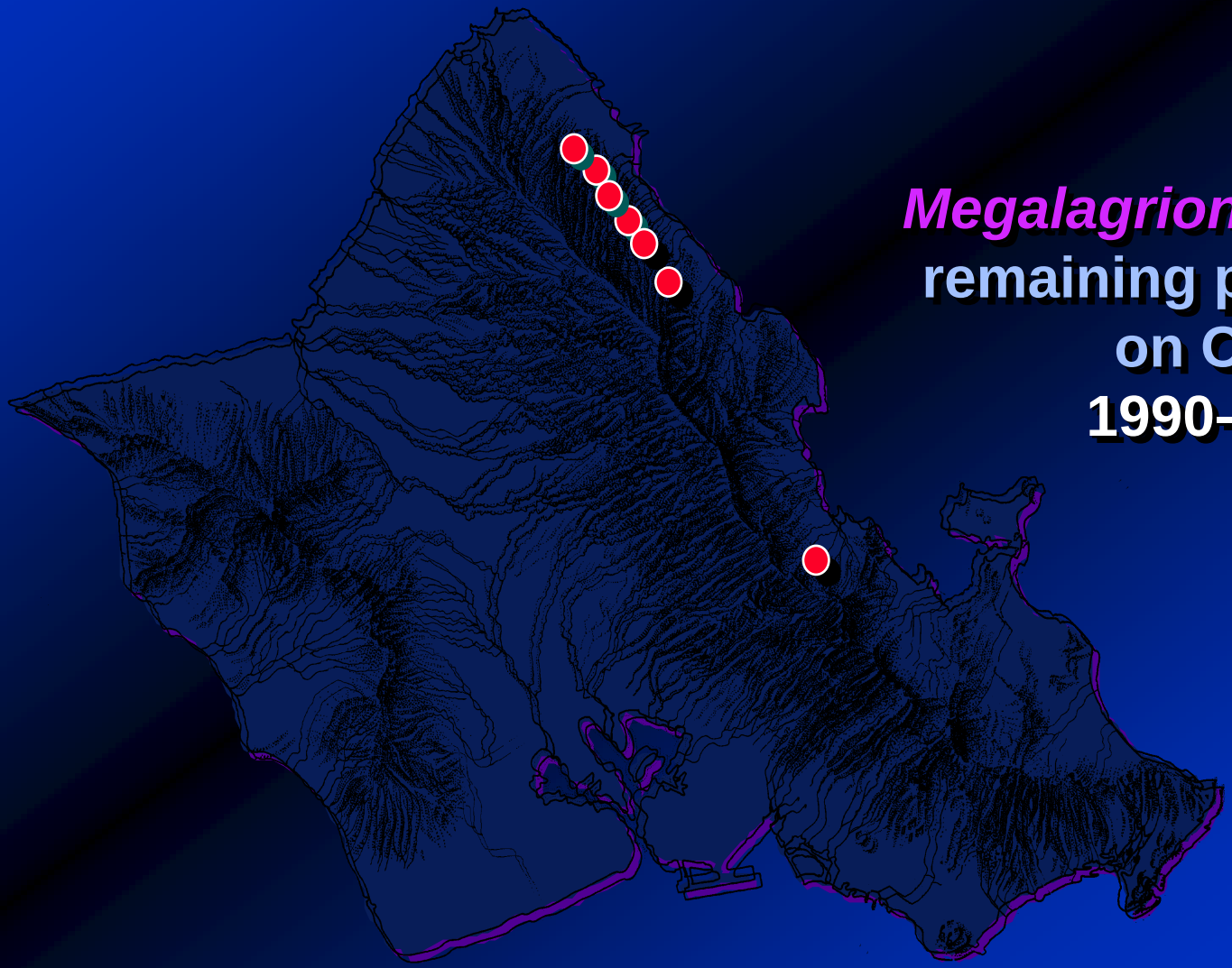
***M. pacificum* (formerly widespread)**

A listing package is under development

If approved, then Critical Habitat will need to be designated

MEGALAGRION

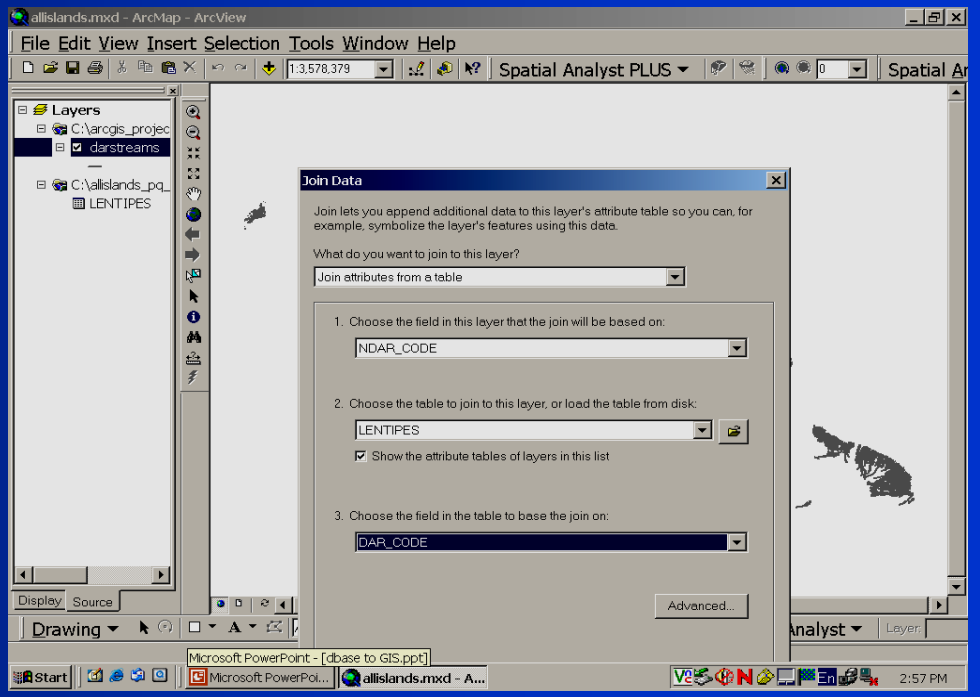
Have a good base of existing survey data from all islands

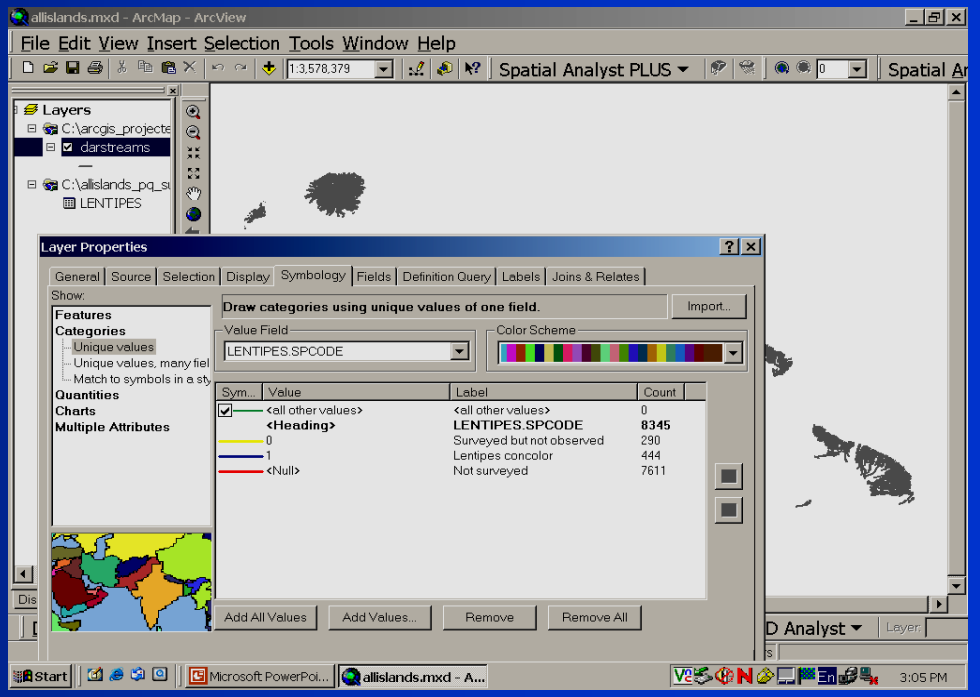


Megalagrion oceanicum
remaining populations
on Oahu
1990–2003

This survey data is easily integrated with GIS

- Data is easily imported/exported
- May be joined to GIS maps to allow informative display

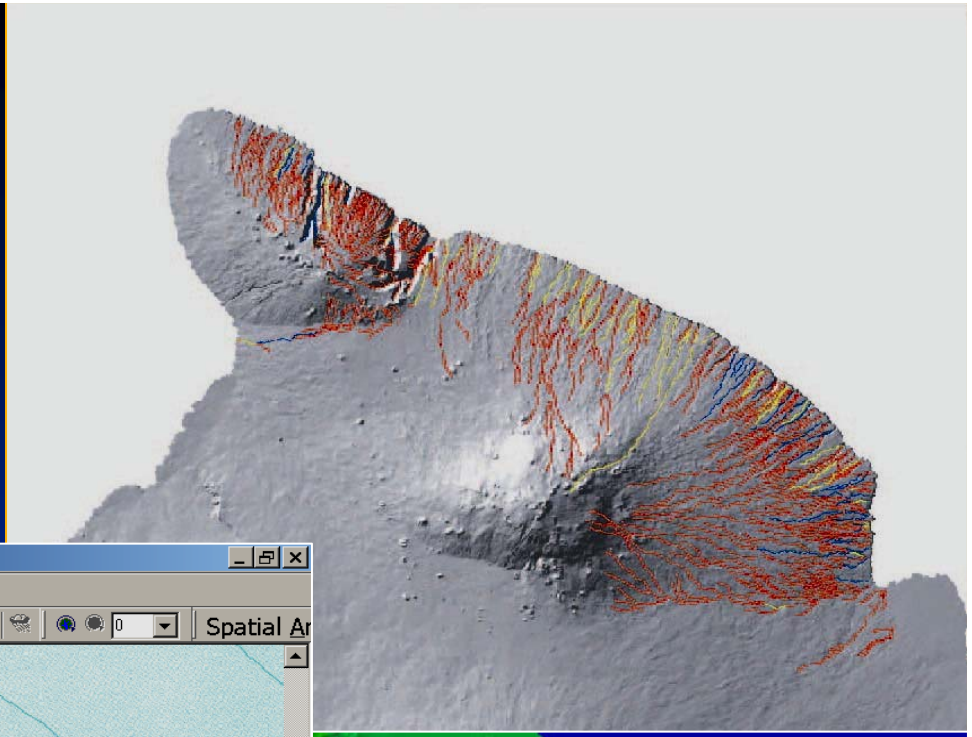


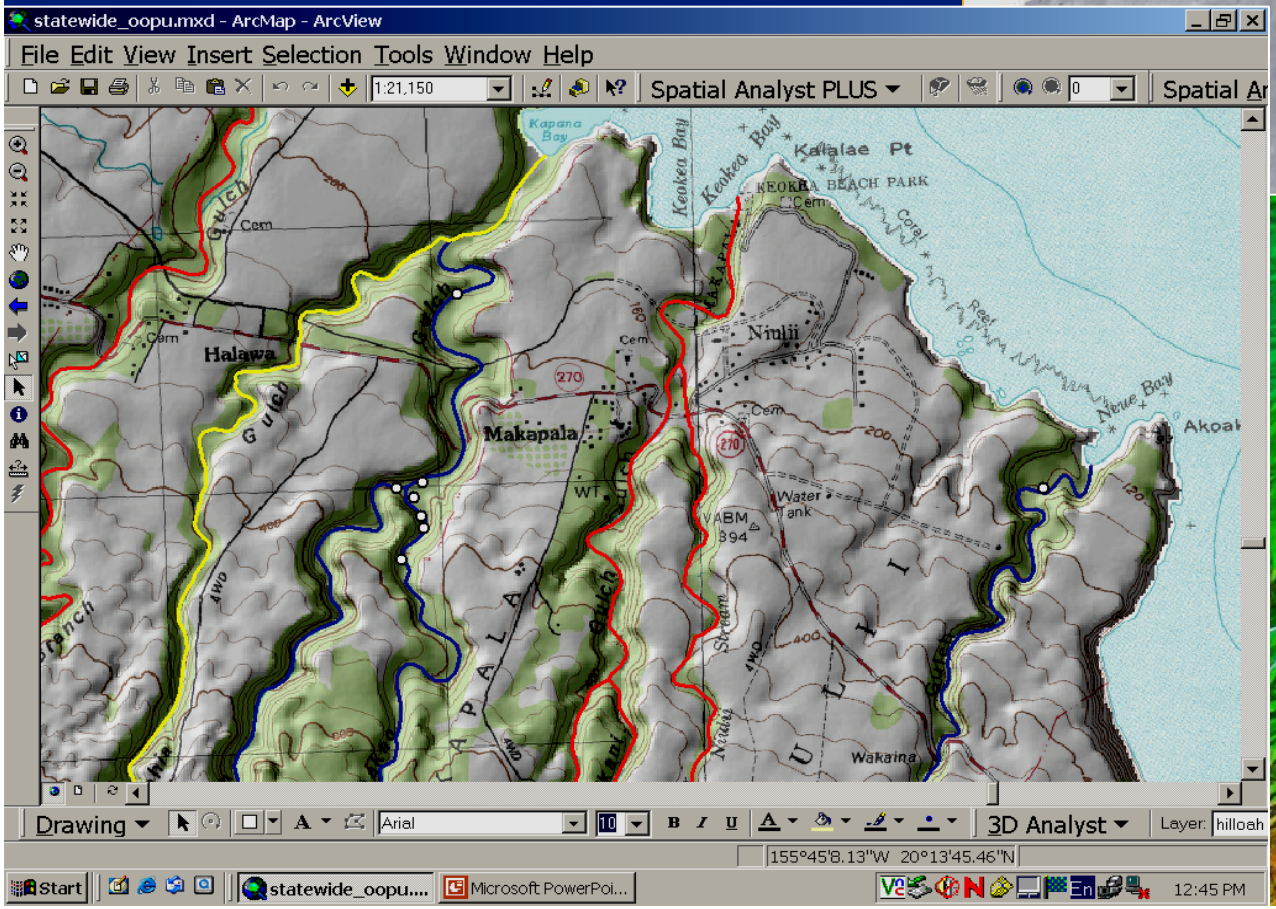


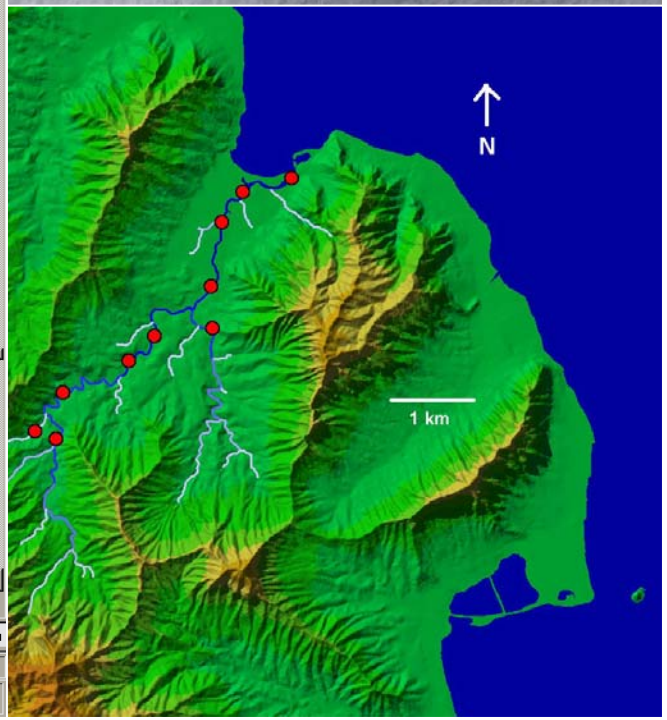
Integration with GIS allows:

- Ability to graphically display database information in a mapped format
- Attribute fields with different types of information to be displayed
- Attributes to be constrained only by the amount of information collected by the surveyors
- Links to information from other disciplines and data sources

Information can be displayed in many ways and at many different scales



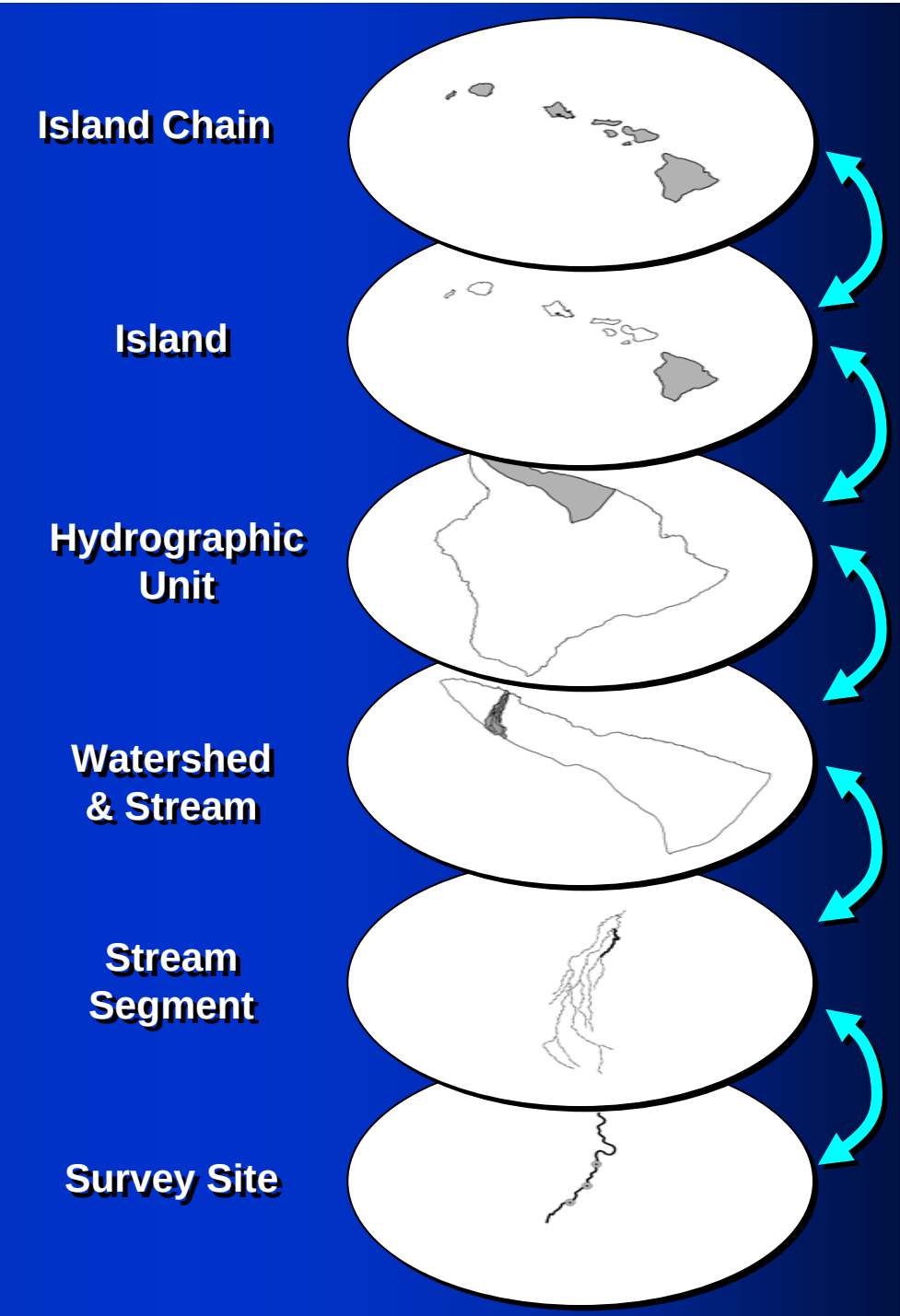




DAR Database Design

Nested Hierarchy

Currently running in MS Access



THE DAR HAWAII STEAM BIOTA DATABASE STRUCTURE

Can be used to organize and output aquatic insect survey data from any island

Provides a useful tool for aquatic insect data management and dissemination

DATABASE OUTPUTS
Information Dissemination

- Quick production of “state of the knowledge” reports for all Hawaiian streams, containing descriptions of their known aquatic insect biotas, both native and introduced
- Production of “state of the knowledge” reports for each individual aquatic insect species surveyed and their known distribution throughout the Hawaiian islands
- Dissemination of the survey information to the public through partnership with Pacific Basin Information Node (PBIN)

Atlas of Hawaiian Watersheds and their Aquatic Resources

JE Parham, Higashi, GR, Lapp, EK, Kuamo'o, DGK, Fitzsimons, JM, Nishimoto, RN, Polhemus, DA and WS Devick

State of Hawaii
Department of Land and Natural Resources
Division of Aquatic Resources
Honolulu, HI

Atlas Key and Map Legend

Legend

- USGS gages
- DAR Point Quadrat Samples
- DAR Impoundment Samples
- DAR Larval Samples
- non-DAR Samples
- Major Roads
- Streams
- Dams
- Ditches

Reach Type

- Estuary
- Lower
- Middle
- Upper
- Headwaters

Stewardship

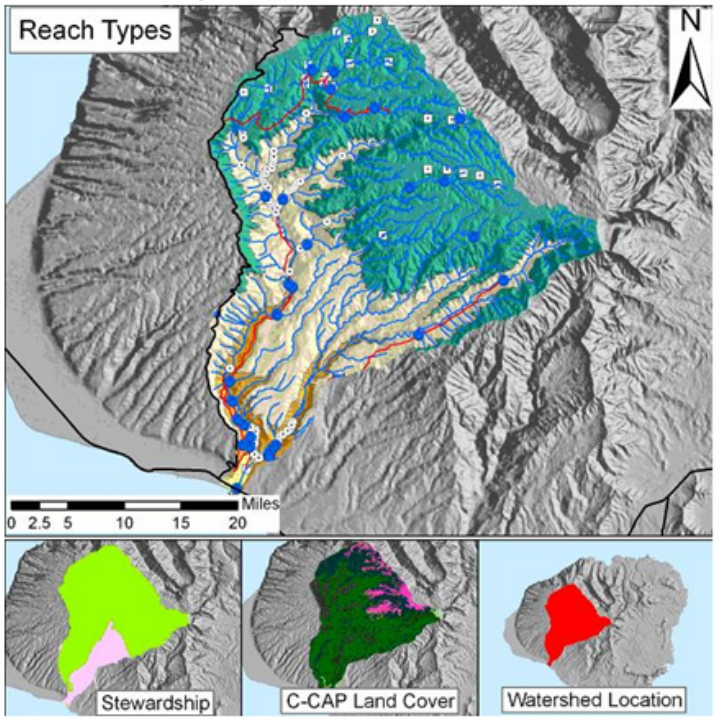
- City and County of Honolulu
- Private Land Owners
- State of Hawaii
- The Nature Conservancy
- United States of America

C-CAP Land Use

- Background
- Bare Land
- Cultivated Land
- Deciduous Forest
- Estuarine Emergent Wetland
- Estuarine Forested Wetland
- Estuarine Scrub/Shrub Wetland
- Evergreen Forest
- Grassland
- High Intensity Developed
- Low Intensity Developed
- Mixed Forest
- Palustrine Emergent Wetland
- Palustrine Forested Wetland
- Palustrine Scrub/Shrub Wetland
- Scrub/Shrub
- Unclassified
- Unconsolidated Shore
- Water

Waimea River, Kauai Island

24004



WATERSHED FEATURES

Waimea River watershed occurs on Kauai Island. It's Hawaiian name is Waimea River and the Hawaiian meaning of the name is reddish water (as from erosion). The area of the watershed is 9.5 square mi (24.7 square km), with maximum elevation of 4287 feet. The watershed's DAR cluster code is 8. The percent of the watershed in the different land use districts is as follows: 12.9% agricultural, 86.6% conservation, 0.1% rural, and 0.4% urban.

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

Military	Federal	State	OHA	County	Nature Conservancy	Other Private
0.0	0.0	78.7	5.4	0.0	0.0	15.9

CONSIDERATIONS FOR RESTORATION

Ditch systems are lateral pathways for invasive fishes

Therefore, ditch flows should not be comingled with restoration flows
in order to avoid biological contamination and subsequent loss of native insect biota

Questions?

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

"Fish for the Future"