Anchialine restoration in Hawai‘i – One pool complex at a time

Megan Lamson, Stacey Breining & Bill Gilmartin
Hawaiʻi Wildlife Fund (wildhawaii.org)
4th Int’l Symposium for Anchialine Ecosystems – Oct 2018
Sacred is the red pond where the red shrimp dwell within.

B. Seidel
Hawaiʻi Wildlife Fund

Our mission is to protect the native wildlife of Hawaiʻi through research, education & conservation projects.
Anchialine Pools in Hawai‘i
Waiʻōhinu Forest Reserve (Hawaiʻi Island)

1,331 acres (538 ha) / 2 mi (3.3 km) of coastline:
- **Plants:** 36 species of native coastal vegetation, including endangered ʻōhai (*Sesbania tomentosa*)
- **Pools:** At least 6 anchialine pools with 3 species of shrimp (*Halocaridina rubra, Metabetaeus lohena, Palaemon debilis*) & a cave
- **Petroglyphs:** Several petroglyph fields & numerous other cultural resources / archeological features
Native wildlife utilizing pools

G. Smith / FWS

M. Kimura

B. Harry / NPS

Utah DNR
Rocks and clocks: linking geologic history and rates of genetic differentiation in anchialine organisms

Scott R. Santos · David A. Weese

Fig. 1 Map of the high Hawaiian Islands depicting anchialine pools where *Halocaridina* were sampled for this study. Inserts Geologic maps, including ages of local basalt (i.e., lava) flows, for the northeastern coast of Maui (A) and the southeastern coast of the island of Hawai‘i (B). Site codes: Waianapanapa Cave (WC), Waikoloa (WKA), Puhi Ula Cave (PU), and Wai‘ohinu (WP)
Native plants in/around pools

Native Plants of Ho'onoua Ponds
Ka'ū Coast, Hawai'i Island

The above native coastal plants are all very common around the archetypal pond ecosystems at Ho'onoua. These plants are currently being threatened by invasive species such as Christmas berry, Fountain grass, and Lantana. HWF is seeking to restore these precious habitats back to their natural state of natives only. Photos by Megan Larson. *Denotes an endemic Hawaiian plant.*
Threats to anchialine ecosystems
Misc. photographers – thank you google.
Restoration Phase II (Sediment)
Restoration Phase III (Fish)

IN PROGRESS...

Photo by John Hoover.
REVIEWED!
According to **Leo Nico of USGS**, they ran similar bioassays in June 2018 with CFT Legumine (rotenone product) on 3 native neritid snails (*Neripteron vespertinum*, *Neripteron vespertinum*, *Nerita picea*) and 2 more invasive fish species: Mollies (*Poecilia sphenops* complex), Western Mosquitofish (*Gambusia affinis*) – all of which are found in anchialine pool ecosystems. 

**Preliminary results**: Mortality of non-native fishes with native inverts relatively unaffected by piscicide.

Manuscript in process – to be submitted to journal by the end of the year.

“detail that our tests showed that CFT Legumine concentrations greater than or equal to 3 ppm (i.e., > 0.15 mg/L rotenone) **achieved 100% mortality of tilapia and 93% of guppies within 24 hours** – whereas there was little or no mortality among invertebrates exposed for 48 to 72 h to 1 to 5 ppm CFT Legumine.”
Re ‘auhuhu (Tephrosia purpurea): “This once common powerful plant is now extremely rare in the main Hawaiian Islands and with its many valuable qualities, it is worthy of propagation and conservation.” – Leina’ala Bright and colleagues

Abstract

This once common powerful plant is now extremely rare in the main Hawaiian Islands and with its many valuable qualities, it is worthy of propagation and conservation.
RESTRICTED USE PESTICIDE
Due to acute inhalation, acute oral, and aquatic toxicity. For retail sale to, and use only by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator’s certification.

THE APPLICATOR IS RESPONSIBLE FOR CONFORMING TO THE LABEL. IMPORTANT GUIDANCE ON THE EFFECTIVE USE OF THIS PRODUCT IS PROVIDED IN THE ROTENONE SOP MANUAL, AVAILABLE FROM THE REGISTRANT OR THE AMERICAN FISHERIES SOCIETY AT www.fisheries.org

FOR CONTROL OF NON-NATIVE, INVASIVE FISH SPECIES IN ANCHIALINE POOLS IN HAWAII

FOR EXPERIMENTAL USE ONLY
Under Hawaii State EUP-
Issue Date:
Expiration Date:

CFT Legumine Fish Toxicant
EPA Reg. No. 89451-

ACTIVE INGREDIENTS:
Rotenone..............................................5% w/w
Cube Resins other than rotenone.............5%
OTHER INGREDIENTS*.........................90%
TOTAL................................................100%
*Contains Petroleum Distillates

KEEP OUT OF REACH OF CHILDREN
WARNING
SEE ADDITIONAL PRECAUTIONARY STATEMENTS, FIRST AID AND PERSONAL PROTECTIVE EQUIPMENT (PPE) ON THE CONTAINER LABEL
### Hoʻonoua Complex Water Quality and Crustacean Survey Averages

<table>
<thead>
<tr>
<th>Pool</th>
<th>Average (Mean)</th>
<th>Temp</th>
<th>pH</th>
<th>Salinity</th>
<th>Diss. O2</th>
<th>Cond.</th>
<th>Shrimp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>25.13</td>
<td>7.70</td>
<td>11.74</td>
<td>84.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pool #1</td>
<td>st. deviation</td>
<td>1.71</td>
<td>0.43</td>
<td>0.86</td>
<td>23.53</td>
<td>0.90</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>minimum</td>
<td>20.48</td>
<td>6.95</td>
<td>10.08</td>
<td>32.94</td>
<td>18.24</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>maximum</td>
<td>28.31</td>
<td>8.53</td>
<td>15.13</td>
<td>121.25</td>
<td>22.18</td>
<td>0</td>
</tr>
<tr>
<td>Pool #2</td>
<td></td>
<td>23.83</td>
<td>7.31</td>
<td>9.45</td>
<td>40.58</td>
<td>17.48</td>
<td>17.64</td>
</tr>
<tr>
<td></td>
<td>st. deviation</td>
<td>1.21</td>
<td>0.48</td>
<td>2.56</td>
<td>27.39</td>
<td>1.07</td>
<td>17.78</td>
</tr>
<tr>
<td></td>
<td>minimum</td>
<td>21.60</td>
<td>6.23</td>
<td>0.10</td>
<td>9.80</td>
<td>15.56</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>maximum</td>
<td>26.20</td>
<td>8.45</td>
<td>12.10</td>
<td>102.90</td>
<td>20.41</td>
<td>60</td>
</tr>
<tr>
<td>Pool #3</td>
<td></td>
<td>26.71</td>
<td>7.93</td>
<td>11.90</td>
<td>75.84</td>
<td>20.91</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td>st. deviation</td>
<td>3.02</td>
<td>0.59</td>
<td>2.50</td>
<td>42.47</td>
<td>4.40</td>
<td>5.72</td>
</tr>
<tr>
<td></td>
<td>minimum</td>
<td>20.30</td>
<td>7.04</td>
<td>0.90</td>
<td>3.70</td>
<td>5.00</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>maximum</td>
<td>32.90</td>
<td>9.07</td>
<td>15.00</td>
<td>159.00</td>
<td>25.70</td>
<td>25.00</td>
</tr>
<tr>
<td>All Pools</td>
<td></td>
<td>25.36</td>
<td>7.69</td>
<td>11.21</td>
<td>69.13</td>
<td>19.67</td>
<td>5.96</td>
</tr>
<tr>
<td></td>
<td>st. deviation</td>
<td>2.47</td>
<td>0.56</td>
<td>2.30</td>
<td>37.25</td>
<td>3.00</td>
<td>12.53</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>87</td>
<td>83</td>
<td>86</td>
<td>38</td>
<td>52</td>
<td>50</td>
</tr>
</tbody>
</table>

**Table 1.** The above table shows the results from water quality samples and crustacean surveys conducted by HWF from 2009-2012 and 2009-2014 respectively.
Education and outreach (ongoing)
Current restoration status

- **Plant control** – ONGOING: 100% invasive plant species removed by hand around pool #1 (hema), 75% and ongoing for pool #3 (‘ākau), plus 90% of the 52 hectares (129 acres) of invasive woody plants treated.
- **Sediment removal** – COMPLETE: Sediment removed two largest pools (to extent possible).
- **Fish removal** – IN PROGRESS: Rotenone administration training completed and re-applying for the experimental use permit (HI DOA), CWA NPDES pesticides general permit (HI DOH \rightarrow US EPA), and Special Activity permits (HI DLNR) for use within anchialine ecosystems.
- **Education and outreach** – CONTINUOUS 😊
Ka ʻinana lā mele ʻōpae ʻula.
Lively and active is the freshwater shrimp, *Halocaridina rubra*.
Mahalo and questions?

¿Preguntas?

¡Gracias!

megan@wildhawaii.org  @wildhawaii