Macrofauna Survey Results for Wailau Stream in Molokaʻi, Hawaiʻi

November 2025 **PR-2025-03**

State of Hawaiʻi
Department of Land and Natural Resources
Commission on Water Resource Management

Acknowledgements
The authors are grateful for the tireless assistance in the field from Douglas Kagawa and Dean Uyeno from the Commission staff, and Wailana Moses from the nonprofit Kānaka Āpau. Palmer Naki provided helpful context regarding ahupua‘a stewardship. We are forever indebted to Kathy Yoda for all her assistance with making fieldwork possible.

Cover Photo: Wailau Stream at 250 feet elevation

Citation: Strauch, A.M., Chacon, C.L., and Kimmel, J. 2025. Macrofauna Survey Results for Wailau Stream in Moloka‘i, Hawai‘i. Commission on Water Resource Management, Public Report PR-2025-03

Macrofauna Survey Results for Wailau Stream in Molokaʻi, Hawaiʻi

By Ayron M. Strauch, Cody L. Chacon, and Jody Kimmel

Background

The Commission on Water Resource Management (Commission) is entrusted with overseeing the protection and management of water resources for the State of Hawaiʻi. The Commission maintains a database of instream values, including traditional and customary practices, aquatic resources, and ecosystem services in order to evaluate the availability of resources and improve outcomes of management decisions.

Wailau Valley, located on the north shore of Molokaʻi, is one of several major valleys formed by the collapse of the East Molokaʻi Volcano approximately 1.4 million years ago. Wailau Stream drains the island's steep windward slopes and flows north into the Pacific Ocean, forming a deeply incised valley bordered by high sea cliffs. Wailau Stream is fed by multiple tributaries originating in the island's central highlands and contributes to the perennial flow that supports riparian and estuarine habitats at its mouth. Historically, Wailau Valley supported extensive Native Hawaiian settlements and wetland kalo cultivation. The stream and valley are part of a remote watershed system that remains largely undeveloped and provides important freshwater, ecological, and cultural resources for Molokaʻi.

Goal

Streams in Hawaiʻi face a range of environmental pressures, including shifting climate, land use change, and invasive aquatic and terrestrial species, which threaten their ecological integrity. We document current ecological and hydrological conditions from October 13-15, 2025 using a standardized approach for comparisons to other watersheds.

Hydrology

We measured streamflow using standard US Geological Survey (USGS) discharge measurement protocols – the midpoint method – at a nearby location with appropriate cross-sectional conditions (Turnipseed and Sauer 2010) (Figure 1). The USGS operates a continuous-record streamflow gaging station (USGS 16415000) on East Fork Kawela Stream near Kamalo, Moloka‘i. This station is located approximately 2.2 miles from the Wailau watershed and provides a record of antecedent hydrological conditions. Mean daily flow prior to the October 2025 surveys on Wailau Stream is depicted in Figure 2.

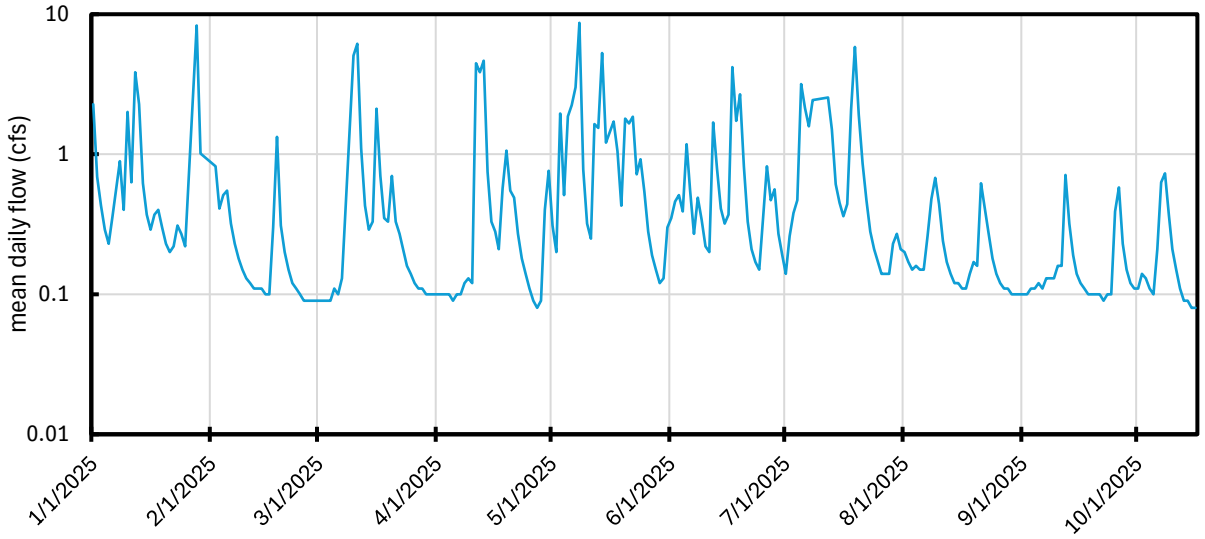

Figure 2. Mean daily flow (cfs) at USGS 16415000 on EF Kawela Stream from January to October 2025.

Methods

We conducted the stream surveys under stable, low-flow conditions focused on stream reaches beginning at five elevations: 5 ft, 80 ft, 200 ft, 400 ft, and 550 ft.

To evaluate macrofauna population density, we utilized the point-quadrat visual snorkel survey method as described by Higashi and Nishimoto (2007). Surveys were conducted using a stratified-random sampling design over approximately 200 meters of stream channel. The stream reach was divided into 10-meter segments, and 20 transects were established perpendicular to flow, beginning at the most downstream point and extending upstream. For each transect, a single point-quadrat survey was conducted at a randomly selected lateral position – either along the left bank, center channel, or right bank. Visual surveys lasted for 120 seconds, during which all macrofauna were identified to species, enumerated, and sized (estimated to the nearest 0.5 inch).

Species density was calculated by dividing the number of individuals of each species observed within a quadrat by the total area of that quadrat, then averaged per stream reach. Endemic amphidromous species – including fishes, crustaceans, and mollusks – and introduced macrofauna were identified to the species. The two native *Kuhlia* species, *Kuhlia xenura* and *K. sandvicensis*, which are difficult to differentiate in the field, were grouped as *Kuhlia* spp.

At each survey location, the dimensions of the quadrat were measured to calculate the area surveyed, and the maximum depth was recorded. Each quadrat was assigned a dominant habitat type – run, pool, or riffle – following the classification system of Higashi and Nishimoto (2007) (Table 1). Substrate composition within each quadrat was estimated visually, with substrate types (e.g., bedrock, boulder, cobble, gravel, sand, silt, and organic matter) recorded to the nearest 5%. Bedrock was defined to include large boulders (intermediate axis > 1 m) and continuous volcanic basal formations, as characterized by Kinzie et al. (1984). Organic matter included leaf litter, decomposed fruit, and coarse woody debris.

Table 1. Example habitats of riffle, run, and pool from Wailau Stream at 400 ft.

A.) riffle

B.) run

C.) pool

Water column velocity for the quadrat was measured at 60% of the total depth at the center of each quadrat using a FlowTracker 2 acoustic doppler velocimeter (SonTek, San Diego, California). At every transect, both wetted width and active channel width were recorded to characterize stream channel dimensions. Canopy cover (%) was estimated at every other transect (n = 10) using CanopyApp (version 1.0.3, University of New Hampshire), and mean canopy cover was calculated for the entire survey reach. Stream channel slope was extracted from Tingley et al. (2019).

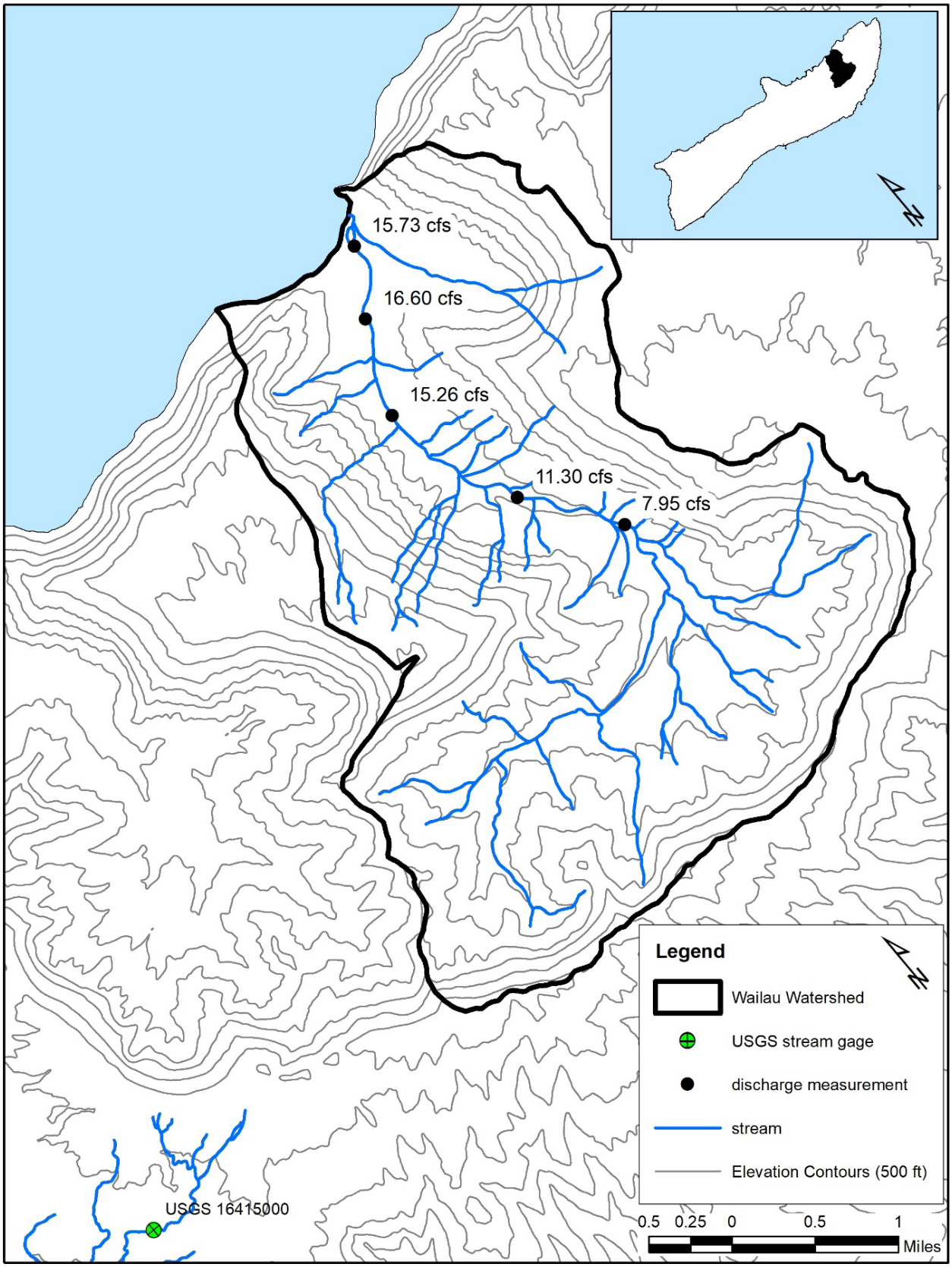

Figure 1. Locations of flow measurements (cfs) conducted along Wailau Stream, Moloka'i in October 2025 in relation to the US Geological Survey station 16415000 on EF Kawela Stream.

Results

Stream Channel Characteristics

Mean channel characteristics varied along Wailau Stream with changes in elevation and distance inland (Table 2). Instantaneous discharge measurements along Wailau Stream ranged from 8.0 to 16.6 cubic feet per second (cfs). Wetted width (WW) and active channel width (ACW) ranged from 11.4 ± 3.1 m to 20.5 ± 3.3 m and 19.7 ± 3.4 m to 29.7 ± 3.2 m, respectively, with the widest channel observed at 200 ft in elevation (Table 2). Mean depth showed substantial variability among reaches, with the deepest mean (57.1 ± 28.5 cm) occurring at 400 ft (Table 2). Mean velocity remained relatively low throughout the stream, ranging from 0.2 ± 0.1 m/s to 0.3 ± 0.2 m/s (Table 2). Canopy cover (%) exhibited an increasing trend downstream, rising from less than 1% in the upper reach (550 ft) to a peak of 43.6 ± 23.5% at 80 ft elevation before declining slightly near the estuary (Table 2). Overall, these data indicate increasing discharge and variable channel morphology along the longitudinal gradient, reflecting the transition from confined upper reaches to more open, laterally extensive lower sections of Wailau Stream.

Table 2. Mean (± standard deviation) stream channel characteristics at varying elevations in Wailau Stream, Moloka'i. [Note: channel slope based on Tingley et al. 2019]

	Elevation (ft)				
Characteristic	**550**	**400**	**200**	**80**	**5**
Distance Inland (km)	4.8	4.0	2.2	0.9	0.5
Discharge (cfs)	8.0	11.3	15.3	16.6	15.7
Temperature (°C)	23.1	22.5	22.7	21.9	25.2
Channel Slope (%)	8.5	4.6	2.7	1.7	0.4
Canopy Cover (%)	0.7 (± 1.8)	2.5 (± 5.7)	18.7 (± 24.7)	43.6 (± 23.5)	9.3 (± 17.3)
Wetted Width (m)	12.2 (± 3.8)	11.4 (± 3.1)	20.5 (± 3.3)	12.5 (± 2.4)	14.6 (± 3.8)
Active Channel Width (m)	20.6 (± 2.9)	19.7 (± 3.4)	29.7 (± 3.2)	22.8 (± 6.2)	25.6 (± 4.7)
Depth (cm)	48.0 (± 20.9)	57.1 (± 28.5)	33.6 (± 13.7)	42.4 (± 24.2)	31.8 (± 10.6)
Velocity (m/s)	0.3 (± 0.2)	0.2 (± 0.3)	0.2 (± 0.2)	0.3 (± 0.2)	0.2 (± 0.1)

Habitat Characteristics

Substrate composition along Wailau Stream varied with elevation (Table 3). Boulder and cobble dominated all reaches, with boulder percentages ranging from 34-48% and cobble from 26-36%. Gravel was more abundant at middle and lower elevation reaches (200 ft to 5 ft; 17-28%). While bedrock was minimal (<10%) throughout. Silt and organic material were consistently low (<7%), and no sand substrate was observed.

Table 3. Mean (± standard deviation) percent (%) substrate distribution per reach at varying elevations along Wailau Stream, Moloka'i.

	Elevation (ft)				
Substrate	**550**	**400**	**200**	**80**	**5**
Bedrock %	2.8 (± 8.8)	9.3 (± 21.7)	0.0	2.0 (± 8.9)	0.0
Boulder %	47.3 (± 27.1)	34.8 (± 27.5)	39.3 (± 18.2)	47.5 (± 29.0)	34.5 (± 20.4)
Cobble %	35.5 (± 24.0)	30.8 (± 19.3)	29.3 (± 17.8)	26.5 (± 22.2)	30.3 (± 17.8)
Gravel %	12.0 (± 13.3)	20.3 (± 18.7)	28.8 (± 18.7)	17.0 (± 17.2)	28.0 (± 16.3)
Silt %	1.5 (± 6.7)	0.0	0.0	1.8 (± 5.4)	1.0 (± 4.5)
Organic %	1.0 (± 3.1)	5.0 (± 13.7)	2.8 (± 6.2)	5.3 (± 11.9)	6.3 (± 8.4)

Habitat types also shifted with elevation (Table 4). Upper reaches (550 ft) were dominated by riffles (50%), while midstream (400 ft) had more runs (56%) and pools (35%). Lower reaches 80-5 ft) were strongly dominated by runs (60-87%), with pools and riffles comprising a smaller proportion of the channel.

Table 4. Mean percent (%) habitat distribution per reach at varying elevations in Wailau Stream, Moloka'i.

	Elevation (ft)				
Habitat	**550**	**400**	**200**	**80**	**5**
Pool %	20	35	25	20	20
Riffle %	50	25	40	20	15
Run %	30	40	35	60	65

Species Densities

Eight aquatic species were recorded along Wailau Stream (Table 5). We observed the greatest densities of *Sicyopterus stimpsoni*, ranging from 6.0 #/m^2 at 80 ft elevation to 8.6 #/m^2 at the 550 ft elevation. *Awaous stamineus* was present at all elevations with mean density ranging from 0.1 to 1.7 #/m^2. We observed *Kuhlia* spp. at three elevations (5 ft, 200 ft, and 400 ft) with density ranging from 0.1 to 1.3 #/m^2. *Eleotris sandwicensis* occurred at lower elevations with density ≤ 0.2 #/m^2. We observed *Lentipes concolor* at 400 ft and 550 ft, with mean density of 0.1 #/m^2 and 0.5 #/m^2, respectively. We only found *Stenogobius hawaiiensis* at the 5 ft (0.3 #/m^2) elevation reach. *Neritina granosa* was present at four of five sites, with mean density ranging from 0.1 to 0.6 #/m^2, while the introduced prawn *Macrbrachium lar* was observed at all sites, with a mean density between 0.1 and 1.3 #/m^2.

Table 5. Mean (± standard error) species densities observed at varying elevations along Wailau Stream, Moloka'i.

	Elevation (ft)				
Species	**550**	**400**	**200**	**80**	**5**
E. sandwicensis	0	0	0.1 (± 0.1)	0.2 (± 0.1)	0.1 (± 0.1)
L. concolor	0.5 (± 0.3)	0.1 (± 0.1)	0	0	0
S. hawaiiensis	0	0	0	0	0.3 (± 0.2)
A. stamineus	0.4 (± 0.2)	1.7 (± 0.5)	1.1 (± 0.3)	0.1 (± 0.1)	0.3 (± 0.2)
S. stimpsoni	8.6 (± 1.2)	8.0 (± 1.2)	6.7 (± 1.4)	6.0 (± 1.3)	7.0 (± 0.9)
***Kuhlia* spp.**	0	0.1 (± 0.1)	0.6 (± 0.3)	0	1.3 (± 0.4)
N. granosa	0.6 (± 0.4)	0.4 (± 0.2)	0.2 (± 0.2)	0.1 (± 0.1)	0
M. lar	1.3 (± 0.4)	1.2 (± 0.3)	0.8 (± 0.4)	0.9 (± 0.3)	0.1 (± 0.1)

Species Sizes

Body size patterns varied among species and elevations along Wailau Stream (Table 6). *Eleotris sandwicensis* was present only below 200 ft, with mean size increasing toward lower elevations. *Awaous stamineus* occurred throughout the stream, and mean length increased downstream. *Sicyopterus stimpsoni* was also found at all sites, with little variation in mean size. *Lentipes concolor* was limited to upper elevations and remained small in size. *Stenogobius hawaiiensis* occurred only at low elevations with slightly larger individuals near the stream mouth. *Kuhlia* spp. were observed at middle and lower elevation reaches, and *N. granosa* was observed across multiple sites with minor variation in size. *Macrobrachium lar* occurred at all elevations, with mean sizes ranging from 2.3 to 3.9 inches.

Table 6. Species sizes in inches [mean (minimum – maximum)] observed at varying elevations along Wailau Stream, Molokaʻi.

	Elevation (ft)				
Species	**550**	**400**	**200**	**80**	**5**
E. sandwicensis	---	---	6.8 (4.5-9.0)	7.7 (6.0-10.0)	10.7 (8.0-12.0)
L. concolor	1.5 (1.0-2.0)	1.5 (1.5-1.5)	---	---	---
S. hawaiiensis	---	---	---	2.0 (2.0-2.0)	2.6 (2.5-3.0)
A. stamineus	3.6 (1.5-7.0)	3.0 (1.0-8.0)	4.1 (1.0-9.0)	6.0 (5.0-7.0)	6.3 (4.0-9.0)
S. stimpsoni	3.2 (1.0-5.0)	3.2 (1.0-7.0)	2.8 (1.0-6.0)	3.0 (0.5-6.0)	3.2 (1.0-6.5)
***Kuhlia* spp.**	---	4.5 (4.0-5.0)	3.8 (2.0-7.0)	---	3.2 (2.0-8.0)
N. granosa	1.9 (1.5-2.0)	2.0 (2.0-2.0)	3.3 (3.3-3.3)	2.0 (2.0-2.0)	---
M. lar	3.3 (1.0-5.0)	3.9 (1.5-5.5)	2.8 (2.0-4.0)	3.1 (1.0-5.0)	2.3 (2.0-2.5)

References

Higashi, G.R., and R.T. Nishimoto. 2007. The point quadrat method: A rapid assessment of Hawaiian streams. In N.L. Evenhuis and J.M. Fitzsimons (Eds.), Biology of Hawaiian streams and estuaries. pp. 305-312. Honolulu.

Kinzie, R.A. III, Ford, J.I., Yuen, A.R., Chow, S.J. 1984. Habitat utilization curves for native Hawaiian stream fish. Water Resources Research Center Special Report No. 6:20:84, University of Hawaiʻi, Mānoa, HI.

Tingley, R.A., Infante, D.M., MacKenzie, R.A., Cooper, A.R., and Tsang, Y.P. 2019. Identifying natural catchment landscape influences on tropical stream organisms: classifying stream reaches of the Hawaiian Islands. *Hydrobiologia*, 826:67-83.

Turnipseed, D.P., and Sauer, V.B. 2010. Discharge measurements at gaging stations. U.S. Geological Survey Techniquest and Methods, book 3, chap. A8. 87 p.