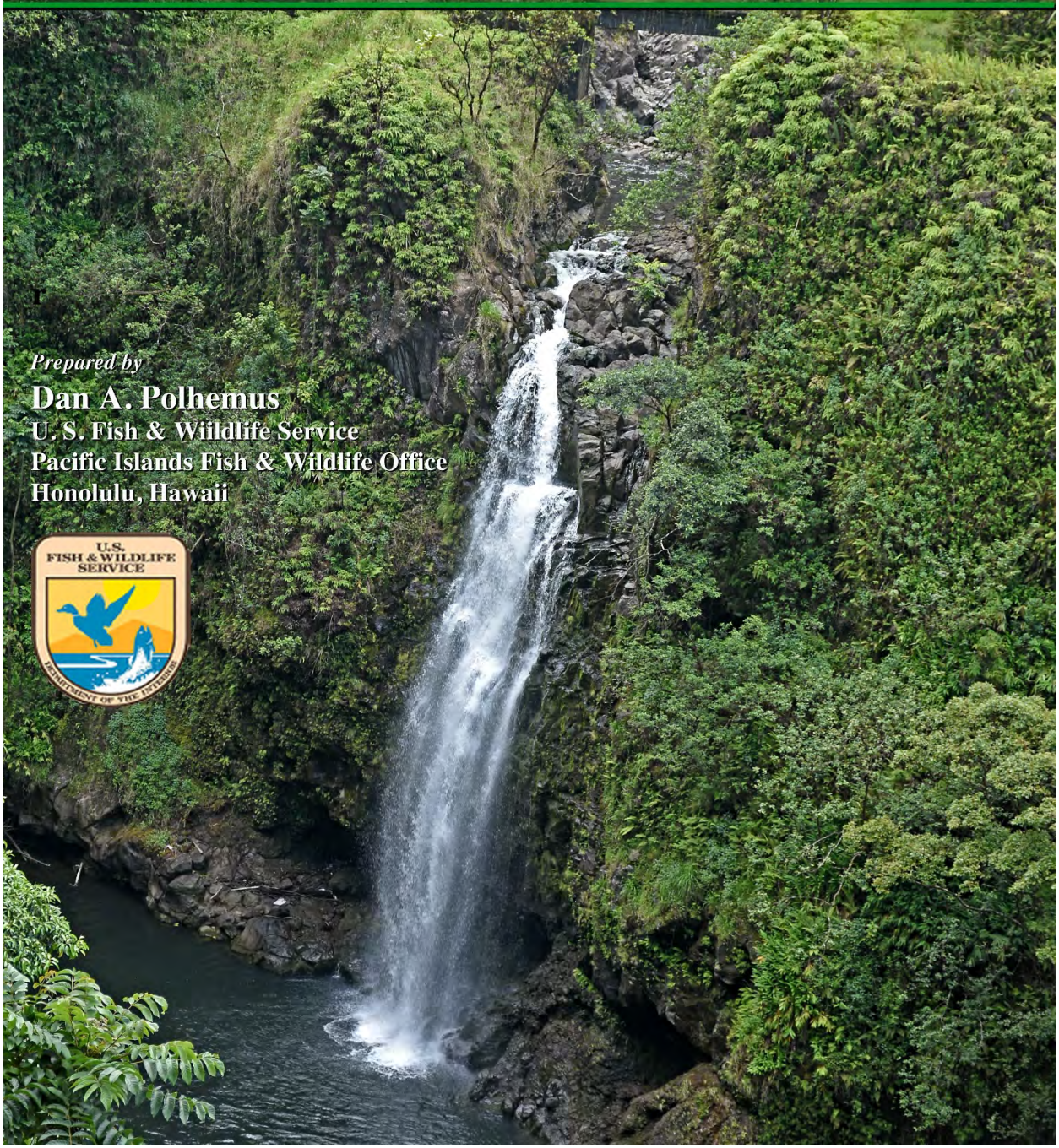
# Field Survey Report

# East Maui Irrigation Ditch System

## East Maui, Hawaii - Stream Diversion Abandonments

### Native Damselfly Baseline Survey - Endangered Species Act

**FINAL REPORT** **October 2019**




*Prepared by*

**Dan A. Polhemus**

U. S. Fish & Wiildlife Service

Pacific Islands Fish & Wildlife Office

Honolulu, Hawaii


Exhibit Y-41

Polhemus, D. A. 2019. East Maui Irrigation Ditch System, East Maui, Hawaii, Stream Diversion Abandonments, Native Damselfly Baseline Survey

U. S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office

Field Survey Report – final draft

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**Cover**: West Wailuaiki Stream at the Koolau Ditch point of diversion K-17.

Field Survey Report

# East Maui Irrigation Ditch System, East Maui, Hawaii, Stream Diversion Abandonments,
## Native Damselfly Baseline Survey

Dan Polhemus

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## Introduction

On 4 March 2019, the Pacific Islands Fish and Wildlife Office (PIFWO) of the U. S. Fish and Wildlife Service (USFWS) received a letter from the State of Hawaii's Commission on Water Resource Management (CWRM) soliciting comment on a proposal from the East Maui Irrigation Company (EMI) to permanently abandon 70 diversions on the northern flanks of Haleakala volcano, Maui island, Hawaii. It was determined by PIFWO staff that the locations for certain of these proposed actions, which were being undertaken to restore minimum instream flows at the direction of CWRM, lay in close proximity to previously documented populations of two native Hawaiian damselflies, *Megalagrion pacificum* and *Megalagrion nesiotes*, currently held as Endangered under the U. S. Endangered Species Act (ESA). It was therefore deemed prudent to undertake field surveys in order to determine if the proposed actions would produce any adverse effects to these listed species.

On 20 and 21 May 2019 inclusive, PIFWO biologist Dan Polhemus was able to join a group of biologists from the State of Hawaii's Department of Land and Natural Resources for a set of surveys at points of diversion proposed for abandonment and lying within State forest reserves. The State group included staff from the Division of Forestry and Wildlife (DOFAW), the Division of Aquatic Resources (DAR), and the Land Division. In all, 14 separate sites were surveyed and evaluated, with 8 of these, lying along the Wailoa, New Hamakua, and Lowrie ditch systems above Haiku, being surveyed on 20 May (Fig. 1), and another 8 sites, lying along the Koolau Ditch east of Keanae, being surveyed on 21 May (Fig. 2). As noted previously, two species of ESA-listed damselflies are currently known to occur in the drainages of northern Haleakala volcano: *Megalagrion pacificum*, a formerly widespread species which breeds in stream overflow channels and occurs as scattered colonies in 12 catchments traversed by the EMI ditch systems (Fig. 3); and the very rare *Megalagrion nesiotes*, a species that is hypothesized to breed terrestrially or on shaded seeps, and is now known from a single population along East Wailuiki Stream above the Hana Road and below the Koolau Ditch point of diversion.

In addition to the above, 5 additional non-listed species of *Megalagrion* are also recorded from the windward Haleakala: *M. blackburni*, *M. hawaiiense* and *M. nigrohamatum*, which form a typical stream-breeding assemblage found in many catchments; *M. calliphya*, which breeds along headwater streamlets; and *M. koelense*, which breeds in the water-filled phytotelmata of *Astelia* and *Freycinetia* plants in upper elevation forests.

The following sections provide the results of the surveys outlined above, followed by a general discussion and recommendations. The survey results are arranged by catchment from east to west, with the surveys undertaken in the upper Haiku sector on 20 May 2019 treated first, followed by the surveys undertaken in the area immediately east of the Koolau Gap on 21 May 2019. Weather on both field days was excellent, with light winds, clear morning skies, and scattered clouds in the afternoons, but no rain.

## Lupi Road Sector

The streams surveyed on 20 May were all accessed via Lupi Road, which runs uphill off the Hana Highway from a gated entrance at Twin Falls. Lupi Road eventually intersects the EMI ditch maintenance road near 1200 feet elevation, and using the latter road the survey party was able to access Honopou Stream, lying to the west, and the Hoolawa, Huelo and Hanehoi streams lying to the east. These four catchments all drain the same broad planeze on the windward slope of Haleakala, bounded on the west by the deep valley of Opana Stream, and on the east by the similarly deep valley of Kailua Stream, both of which head at elevations above 4000 feet. All of the other drainages lying within the roughly trapezoidal sector bounded by these two large gulches, including the streams listed below, occupy less deeply incised valleys and have headwaters originating at or below 2800 feet elevation. The general surface geology of this portion of Haleakala consists of flows from the Kula lava series, over which the streams cascade in a stair-step profile of alternating vertical falls and lower gradient reaches. Along the lower sections of these streams, within a mile of the sea, the older, underlying Honomanu series lavas have also been exposed, generally forming large waterfalls that create significant interruptions in the bed profiles, often marking the transition from the terminal reach to the midreach as one progresses upstream. On the way back down Lupi Road a side trip was made to the Lowrie Ditch at the Long Strainer, lying at 600 feet elevation. This was the only site visited on the Lowrie Ditch system during the present survey.

## Honopou Stream

The Honopou Stream catchment lies on the northeastern slope of Haleakala volcano in eastern Maui. The stream is approximately 5 miles in length, heading at an elevation near 2200 feet on the flanks of a small secondary cone called Ulalena, and entering the sea between Puniawa Point and Honopou Point. The biological characteristics of Honopou Stream were studied in detail by Higashi et al. (2008a), and the general hydrology and physical characteristics of the Honopou catchment were reported on in similar detail by the State of Hawaii's Commission on Water Resource Management (2008a). Readers wishing additional details in regard to the physical and biological characteristics of this stream are referred to these studies.

### *Survey Stations*

Two survey stations were investigated along the midreach of Honopou Stream (Fig. 1) on 20 May 2019. Their locations and attributes were as follows (stations are listed in the order in which they were accessed):

**Station 1a** – Honopou Stream at New Hamakua Ditch intake NH-22 (Fig. 3).

20°53’10”N, 156°15’08”W (20.88637, -156.25240).

Surveyed on 20 May 2019, 10:00-11:00 hrs., elevation 1194 ft., water temp**.** 23.3° C. Weather clear and sunny.

Odonata species observed – *Pantala flavescens*.

*Comments* – The point of diversion lies at a sloping cascade over bedrock (Fig. 3), which represented suitable habitat for the large native damselfly *M. blackburni*, but this species was not in evidence despite the good weather. The indigenous dragonfly *Pantala flavescens* was seen hovering above a shallow pool just downstream where the ditch maintenance road crosses via a ford. Immediately east of this ford, water was seeping into the stream channel from leaks in the masonry of an old ditch spillway, creating small side pools in bedrock that represented potentially excellent habitat for other *Megalagrion* damselflies. Despite a diligent search, however, none were seen here. Other stream invertebrates present at this site were the native prawn *Atyoides bisulcata*, and the introduced prawn *Macrobrachium lar*.

**Station 1b** – Honopou Stream at Wailoa Ditch intake W-22 (Fig. 4).

20°53’09”N, 156°15’09”W (20.88576, -156.25250).

Surveyed on 20 May 2019, 10:00-11:00 hrs., elevation 1250 ft., water temp**.** 23.3° C. Weather clear and sunny.

Odonata species observed – None

*Comments* – During surveys in 2008 the ESA-listed damselfly *M. pacificum* was found upstream of this point of diversion beyond the first waterfall upstream, but not at the diversion itself. A brief reconnaissance upstream toward the first waterfall during the current survey did not produce any new sightings of this species. The slopes adjoining the stream above the diversion were boggy and grassy, with considerable evidence of rooting by feral pigs. The stream corridor vegetation at this site was a mix of introduced species including guava, kukui, Job’s tears, and *Clidemia*.

**Station 2** – Tributary to Honopou Stream at Lowrie Ditch intake L-15 at Long Strainer (Figs. 17-19).

20°54’33”N, 156°14’47”W (20.90913, -156.24649).

Surveyed on 20 May 2019, 14:00-14:30 hrs., elevation 600 ft., water temperature not taken. Weather clear and sunny, hot.

Odonata species observed – None

*Comments* – The Lowrie Ditch at this point was not flowing, and consisted of stagnant reaches partially overgrown by invasive weeds (Figs. 17-19). The surrounding vegetation consisted of scattered koa and ohia trees with an understory of introduced ferns, weeds and *Clidemia*. No Odonata were seen.

## Hoolawa Stream

The Hoolawa Stream catchment lies on the northeastern slope of Haleakala and is approximately 6 miles in length, heading at an elevation near 2800 feet, upslope and to the east of a small secondary cone called Ulalena, and entering the sea between at Hoolawa Bay. The catchment has two major branches, the Hoolawanui to the west, which is by far the longer, and the Hoolawaliilii to the east. Both of these branches were previously surveyed by the author in 2008 at their points of diversion on the EMI ditch system, and both were found to harbor populations of native *Megalagrion* damselfly species, including the ESA-listed *M. pacificum*. The biological characteristics of Hoolawa Stream have not been studied in detail, because the stream was not included in the set of detailed biological surveys undertaken on windward Haleakala by DAR in 2008. Similarly, there is no Instream Flow Standard Assessment Report for Hoolawa Stream from the State of Hawaii's Commission on Water Resource Management, therefore the details of the catchment's physical characteristics and hydrology are poorly constrained. Casual observations indicate that this system discharges a base flow that is significantly greater than that of either Honopou or Hanehoi streams, whose catchments flank it to the west and east respectively, and this system is therefore worthy of additional biological investigation.

### *Survey Station*

One survey station was briefly examined in the Hoolawa stream catchment. This was a western tributary to Hoolawanui Stream, at intake NH-20, which was not investigated during previous surveys in 2008. Little time was spent here on the current survey because no modification or abandonment is proposed at this site. Even so, the amount of discharge (Figs. 5, 6) indicates that this stream reach represents potentially suitable habitat for *Megalagrion* damselfly species.

**Station 3** – Tributary to West Hoolawanui Stream at New Hamakua Ditch intake NH-20 (Lupi Intake) (Figs 5, 6).

20°53'08"N, 156°14'48"W (20.88568, -156.24666).

Surveyed on 20 May 2019, 11:30-11:45 hrs., elevation 1200 ft., water temperature not taken. Weather thin overcast with filtered sunlight.

Odonata species observed – None.

*Comments* – The brief stop at this site was only sufficient to allow photographs of the substantial discharge emerging from this catchment. Future surveys should be made here, at and above the Wailoa Ditch point of diversion (W-21, Lupi Small Intake), in order to determine

the presence or absence of ESA-listed *Megalagrion* damselfly species. Neither of the intakes here (NH-20 and W-21) is currently slated for modification or abandonment.

## Hanehoi Stream

The Hanehoi catchment lies on the northern slope of Haleakala and is less than 3 miles in length, heading at an elevation of approximately 1800 feet on the broad slopes east of the secondary summit of Ulalena, and entering the sea via a terminal waterfall at Hoalua Bay. The Hanehoi system has a major western tributary, Huelo Stream, which heads at elevations mostly below the alignment of the EMI ditch system, and its confluence with the Hanehoi occurs downslope of the Hana Highway. Due to this difference in the elevation of the headwaters, the main stem Hanehoi has points of diversion at all 4 of the EMI ditches (Haiku, Lowrie, New Hamakua and Wailoa), whereas the Huelo is diverted only at the Haiku and Lowrie ditches. The biological characteristics of the main stem of Hanehoi Stream (ie., the eastern branch of this catchment) were studied in detail by Higashi et al. (2008b), and the general hydrology and physical characteristics of the Hanehoi catchment were reported on in similar detail by the State of Hawaii's Commission on Water Resource Management (2008b). Readers wishing additional details in regard to the physical and biological characteristics of this stream system are referred to these studies.

### *Survey Stations*

Four survey stations were investigated along the midreach of Hanehoi Stream (Fig. 1) on 20 May 2019. Their locations and attributes were as follows (stations are listed from west to east):

**Station 4** – Tributary to upper Huelo Stream below spillway on New Hamakua Ditch west of intake NH-17A (Figs. 7, 16).

20°53'13"N, 156°14'00"W (20.88696, -156.23341).

Surveyed on 20 May 2019, 13:00-13:15 hrs., elevation 1195 ft., water temperature not taken. Weather thin overcast with filtered sunlight.

Odonata species observed – None.

*Comments* – A brief stop was made at this site because the ESA-listed damselfly M. pacificum had been recorded here in 2008. No individuals were seen during this short survey, and time did not permit a more thorough examination of the habitat.

**Station 5** – Hanehoi Stream tributary at New Hamakua Ditch intake NH-17A (Figs. 9, 10).

20°53'11"N, 156°13'57"W (20.88656, -156.23241).

Surveyed on 20 May 2019, 13:20-13:40 hrs., elevation 1195 ft., water temperature not taken. Weather thin overcast with filtered sunlight.

Odonata species observed – None.

*Comments* – The stream channel here was small, and heavily overgrown, and as such difficult to discriminate as an actual drainage (Figs. 9, 10). No surface flow was observed. A large, tangled treefall was blocking the New Hamakua Ditch upstream of this point (Fig. 8).

**Station 6a** – Hanehoi Stream at New Hamakua Ditch intake NH-17 (Figs. 11, 12, 15).

20°53’04”N, 156°13’52”W (20.88440, -156.23117).

Surveyed on 20 May 2019, 12:00-12:45 hrs., elevation 1195 ft., water temp**.** 23.3° C. Weather thin overcast with filtered sunlight.

Odonata species observed – *Megalagrion pacificum*.

*Comments* – The ESA-listed native damselfly *M. pacificum* was abundant here in the partially de-watered reach lying downstream from Wailoa Ditch intake W-17 and upstream of New Hamakua Ditch intake NH-17 (Figs. 11, 15). At least 20 individual males were observed at various times, perching on prominent midstream rocks and on vegetation bordering the stream channel (Fig. 12) where they defended mating territories. Additional individuals were also seen along the undiverted reach immediately above intake W-17. The presence of *M. pacificum* at this site had been previously confirmed during surveys undertaken in 2008 (Higashi et al. 2008b).

**Station 6b** – Hanehoi Stream at Wailoa Ditch intake W-17 (Figs. 13, 14).

20°53’01”N, 156°13’53”W (20.883672, -156.231490).

Surveyed on 20 May 2019, 12:00-12:45 hrs., elevation 1220 ft., water temp**.** 22.7° C. Weather thin overcast with filtered sunlight.

Odonata species observed – *Megalagrion pacificum*.

*Comments* – See comments above. The ESA-listed native damselfly *M. pacificum* was present here, and also along the freely flowing, undiverted reach immediately upstream, although time constraints did not permit extensive upstream reconnaissance. Stream corridor vegetation at this site consisted of guava, uluhe fern, Job’s tear and *Clidemia*, with a single native *Cyrtandra* growing from the mossy concrete of the diversion structure. Other native aquatic insect species observed at this location included the water bug *Microvelia vagans* (Heteroptera), and the water skating fly *Campsinemus truncatus* (Diptera).

# Wailuaiki Road Sector

The streams surveyed on 21 May (Fig. 2) were all accessed via Wailuaiki Road, which runs uphill from the Hana Highway from a gated entrance a short distance to the east of West Wailua Iki Stream. This road runs uphill a short distance before making a T-junction with the EMI ditch maintenance road. This latter road was then taken to the west, making a steep, narrow descent to a bridge over West Wailua Iki Stream, then continuing on a gradual contour around ridge spurs to East Wailuanui and West Wailuanui streams, and crossing various small tributaries of East Wailuanui in the process. Beyond West Wailuanui the road rounds a ridge spur devoid of streams, and is then blocked by treefalls. Further progress was made on foot in and attempt to reach Waiokamilo Stream, but this was eventually abandoned due to time constraints, although several tributaries to the Waiokamilo were examined.

All of the streams examined on this day drain from a broad slope immediately to the southeast of the Koolau Gap, discharging to a common terminus in Wailua Nui Bay. The general surface geology of this portion of Haleakala consists of flows from the Kula lava series, over which the streams cascade in a stair-step profile of alternating vertical falls and lower gradient reaches, with some of the waterfalls being of substantial size, and representing impediments to longitudinal survey. Along the lower sections of these streams, within a mile of the sea, the older, underlying Honomanu series lavas have also been exposed, generally forming large waterfalls that create significant interruptions in the bed profiles. Below these falls are relatively short, gentle terminal reaches, with seaward berms of rounded lava cobbles.

## Wailuanui Stream

The Wailuanui catchment lies on the northeastern slope of Haleakala immediately to the east of the Koolau Gap, and approximately 7.5 miles in length, heading at an elevation of approximately 8000 feet near the rim of Haleakala crater, and entering the sea via a low gradient terminal reach at Wailua Nui Bay. The Wailuanui system has two major branches, the West Wailuanui, which is much longer and carries a higher discharge volume, and the East Wailuanui, which heads at an elevation near 2200 feet and therefore has a smaller catchment and lower discharge volume. Both stream branches, and their associated tributaries, are diverted by EMI's Koolau Ditch, which runs at an elevation near 1250 feet. The biological characteristics of both branches of Wailuanui Stream from sea level to 1300 feet were studied in detail by Higashi et al. (2008c), and the general hydrology and physical characteristics of the Wailuanui catchment were reported on in similar detail by the State of Hawaii's Commission on Water Resource Management (2008c). Readers wishing additional details in regard to the physical and biological characteristics of this stream system are referred to these studies.

### *Survey Stations*

**Station 7** – East Wailuanui Stream at Koolau Ditch intake K-18 (Figs. 20, 21).

20°49'16"N, 156°08'25"W (20.821273, -156.140419).

Surveyed on 21 May 2019, 09:30-10:00 hrs., elevation 1280 ft., water temp**.** 21.3° C. Weather clear, sunny.

Odonata species observed – *Megalagrion nigrolineatum nigrolineatum, Megalagrion hawaiiense*.

*Comments* – East Wailuanui stream along the reach surveyed was a clear, moderately swift stream flowing in a rocky, unshaded bed lined by introduced grasses and scattered guava trees (Figs. 20, 21). A tandem pair of the native damselfly *Megalagrion nigrohamatum nigrohamatum* was observed in the vicinity of the K-18 diversion structure, indicating a breeding population in this area, and a single individual of *Megalagrion hawaiiense* flew across the road as the party was crossing this stream on the return trip later in the day. No ESA-listed *Megalagrion* species were seen at this location.

**Station 8** – Tributary to East Wailuanui Stream at Koolau Ditch intake K-19 (Figs. 22, 23).

20°49’20”N, 156°08’27”W (20.822326, -156.140790).

Surveyed on 21 May 2019, 10:10-10:30 hrs., elevation 1280 ft., water temp**.** not taken. Weather clear, sunny.

Odonata species observed – *Megalagrion nigrolineatum nigrolineatum, Megalagrion blackburni, Ischnura posita*.

*Comments* – This site presented several types of freshwater habitats, including standing pools in the currently inactive Koolau Ditch (Figs. 22), and a small, shallow stream flowing in a rocky, partially shaded bed lined by grasses and guava trees (Figs. 23). No Odonata were seen at the pools along the ditch, but the small stream, a tributary to East Wailuanui Stream, supported a moderately rich assemblage of damselfly species, including the native *Megalagrion blackburni* and *Megalagrion nigrohamatum nigrohamatum*, and the introduced *Ischnura posita*. No ESA-listed *Megalagrion* species were seen at this location.

**Station 9** – Tributary to East Wailuanui Stream at Koolau Ditch intake K-20 (Fig. 24).

20°49’23”N, 156°08’28”W (20.823086, -156.141289).

Surveyed on 21 May 2019, 10:40-11:00 hrs., elevation 1280 ft., water temp**.** 23.9° C. Weather clear, sunny.

Odonata species observed – *Megalagrion hawaiiense*.

*Comments* – At this site a small, shallow tributary to East Wailuanui Stream passed through a slot in a low weir at intake K-20 (Fig. 24). The channel above the diversion was overtopped by a tangle of introduced guava and other low trees that made transit along it difficult, and no Odonata were seen there. The adjacent Koolau Ditch was masonry-lined at this point, and

though carrying no water, still retained moist walls and bottom, creating artificial seep habitat. One individual of the native damselfly *Megalagrion hawaiiense* was seen briefly here, and it is assumed that this seep-breeding species is utilizing the habitat provided by the de-watered ditch. No ESA-listed *Megalagrion* species were seen at this location.

**Station 10** – Tributary to East Wailuanui Stream at Koolau Ditch intake K-20A (Fig. 25).

20°49’27”N, 156°08’32”W (20.824059, -156.142130).

Surveyed on 21 May 2019, 11:10-11:30 hrs., elevation 1275 ft., water temp**.** not taken. Weather clear, sunny.

Odonata species observed – None.

*Comments* – This site consisted of a pipe which diverts a tributary of East Wailuanui Stream at the head of a waterfall face and conveys the water downward into a bulkhead leading to intake 20A on the Koolau Ditch (Fig. 25). The diversion does not appear to be currently active, and water was being released from a valve into the streambed, forming a broad, shallow pool where the EMI ditch maintenance road crosses. The bedrock faces to either side of the pipe were seeping and wet, supporting lush riparian vegetation. Although this appeared to be potentially good habitat for certain native *Megalagrion* damselfly species such as *M. hawaiiense* or *M. nesiotes*, no Odonata of any type were seen at this location, even under excellent weather conditions.

**Station 11** – West Wailuanui Stream at Koolau Ditch intake K-21 (Figs. 26-30).

20°49’29”N, 156°08’42”W (20.824739, -156.144983).

Surveyed on 21 May 2019, 11:40-12:30 hrs., elevation 1275 ft., water temp**.** 24.3° C. Weather clear, sunny.

Odonata species observed – *Anax strenuus, Pantala flavescens*, *Megalagrion hawaiiense*.

*Comments* – West Wailuanui Stream at this site is a large, high-volume catchment that clearly experiences wide fluctuations in discharge rate, as shown by the clean, scoured nature of the channel and the deposition of extensive cobble berms. The stream above the road crossing and associated intake K-21 lie at the lip of a high waterfall, with a deep gorge below containing a deep plunge pool (Fig. 27). This area was not accessible. Above the bridge, the stream occupies a broad, unshaded bed of gentle gradient, which may be traversed for several hundred feet before another high waterfall is reached (Fig. 26). A small tributary with lush riparian vegetation also enters from the east bank just upstream of the road crossing (Fig. 30), and the bedrock walls next to the waterfall supported seeps with numerous ferns and hydrophytes. Despite this diverse array of habitats, coupled with sunny weather, no *Megalagrion* damselflies were seen along the stream at this location, although the native dragonflies Anax strenuus and Pantala

flavescens were both present in low numbers. A female of the seep-breeding species *Megalagrion hawaiiense* was eventually observed ovipositing at the base of seeping bedrock walls formed by a road cut to the east of the bridge (Fig. 28); this female exhibited the blue thoracic striping characteristic of *M. hawaiiense* populations occurring at lower elevations on windward Haleakala (Fig. 29). No ESA-listed *Megalagrion* species were seen at this location. Other native aquatic insect species observed here included the water bug *Microvelia vagans* (Heteroptera), and the water skating fly *Campsinemus truncatus* (Diptera). The predominant riparian vegetation at this site consisted of guava and introduced grasses.

## Waiokamilo Stream

The Waiokamilo catchment is approximately 5.3 miles in length, and lies on the northeastern slope of Haleakala, running along the east side of the Koolau Gap. The stream heads at about 3600 feet elevation on the slopes above the gap, and flows for about 3 miles before cascading over the east wall of the gap, after which it follows a much lower gradient across the floor of the gap before entering the sea via Waiokilo Falls. In its upper course the stream has a channel incised in the Kula lava series, while its lower course in the Koolau Gap runs over later Hana lava flows of Pleistocene age, in which the channel is only weakly incised. The EMI Koolau Ditch system formerly had 18 points of diversion arrayed along the south wall of the gap where small springs drain down to the main Waiakamilo Stream channel far below, but all of these appear to have been inactivated around 2007, and as far as can be determined from current EMI records, there are no active diversions remaining in the Waiokamilo System. The biological characteristics of Waiokamilo Stream from sea level to 600 feet were studied in detail by Higashi et al. (2008d), and the general hydrology and physical characteristics of the Wailuanui catchment were reported on in similar detail by the State of Hawaii's Commission on Water Resource Management (2008d). Readers wishing additional details in regard to the physical and biological characteristics of this stream system are referred to these studies.

### *Survey Stations*

**Station 12** – Tributary to Waiokamilo Stream along EMI ditch road.

20°49'42"N, 156°08'47"W (20.828261, -156.146449).

Surveyed on 21 May 2019, 13:00-13:15 hrs., elevation 1250 ft., water temperature not taken. Weather clear, sunny.

Odonata species observed – *Pantala flavescens*.

*Comments* – This stream consisted of a set of muddy pools upstream of the EMI ditch road. A short stop here resulted in the sighting of a single indigenous *Pantala flavescens*. This stream is bypassed by the EMI Koolau Ditch system, which runs through a tunnel in the ridge at this point, and is thus not subject to diversion.

**Station 13** – Tributary to Waiokamilo Stream along EMI ditch road.

20°49’40”N, 156°08’53”W (20.827738, -156.147992).

Surveyed on 21 May 2019, 13:25-13:40 hrs., elevation 1240 ft., water temperature not taken. Weather clear, sunny.

Odonata species observed - None.

*Comments* – This was a small stream with clear flow, forming a set of riffles and pools. Although the habitat appeared good, no Odonata were seen here. This stream is bypassed by the EMI Koolau Ditch system, which passes through a tunnel in the ridge, and is thus not subject to diversion.

**Station 13** – Seeps along EMI ditch road above Waiokamilo Stream valley.

20°49’38”N, 156°08’58”W (20.827125, -156.149361).

Surveyed on 21 May 2019, 13:45-14:00 hrs., elevation 1230 ft., water temperature not taken. Weather clear, sunny.

Odonata species observed – *Megalagrion hawaiiense*.

*Comments* – This was a set of dripping seeps in a cut bedrock wall along the upstream side of the EMI ditch road. The native damselfly *Megalagrion hawaiiense* was moderately abundant here, although wary, with individuals departing upon the approach of our hiking party. This site does not lie along the alignment of the EMI Koolau Ditch and is not subject to any current water diversions.

## Results

During the course of this survey, 13 separate sites were surveyed within the Honopou, Hoolawa, Hanehoi, Waiokamilo and Wailuanui stream catchments (Figs. 1, 2). Of these sites, 10 lay at points of diversion along various ditches within the EMI system, with all of these diversions being proposed for permanent abandonment. The proposed design measures for restoring flow in these streams, which involve fluming the clean upland stream waters over the existing ditches, are commendable, in that they avoid the intermixing of ditch waters containing invasive fishes with stream waters from upland sources devoid of such fishes, as per the recommendations in Higashi et al. (2008a, 2008b).

Of the ditch systems surveyed, only the Wailoa Ditch, with the highest elevation alignment, currently appears to be active. The Koolau Ditch where it was encountered as an open channel was dry or held only remnant pools (Fig. 22); the New Hamakua Ditch was not flowing in the area near Hanehoi Stream and was blocked at various points by tree falls and small land slips (Figs. 8, 16); and the Lowrie Ditch was filled with standing water and overgrown with weeds in the area around the Long Strainer (Figs. 17-19). Discussions with EMI indicated that the furthest east intake from which water was currently being

obtained was at Puohokamoa Stream, which would mean that no diversions are currently occurring along the Koolau Ditch to the east of the Koolau Gap. It is clear that prolonged lack of maintenance will eventually render these ditch systems defunct, but any standing waters they retain will provide habitat for invasive species such as mosquitoes and introduced topminnows, which have deleterious effects on ESA-listed native bird and damselfly species respectively (Englund 1999). Conversations with EMI staff indicated that although the ditch system as a whole is potentially capable of delivering 445 million gallons per day (mgd), it is currently carrying only 23 mgd, primarily to service the Maui County municipal water system and to supply fire control reservoirs. Given that the EMI system overall consists of 388 separate intake structures, 24 miles of ditches, 50 miles of tunnels, 12 inverted siphons, and numerous other small intakes, pipes and flumes, there is a need to consider how this water delivery infrastructure, which is now far in excess of current or reasonably projected future needs, can be thoughtfully downsized and rendered biologically benign, while still providing necessary services.

Native *Megalagrion* damselflies were observed at 5 of the points of diversion, as well as at one other roadside seep not associated with any EMI ditch or diversion structure. Of these 6 total sites, one lay in the Hanehoi catchment, 4 in the Wailuanui catchment, and 1 in the Waiokamilo catchment. Overall, 4 species of *Megalagrion* were observed across all sites: the ESA-listed *M. pacificum* at Hanehoi Stream (Fig. 12), and the non-listed species *M. blackburni*, *M. nigrohamatum nigrohamatum*, and *M. hawaiiense* (Fig. 29) along various tributaries of upper Wailuanui Stream (Stations 7, 8, 9 and 11), with the latter species also present at seeps above Waiokamilo Stream (Station 13). One introduced damselfly species, *Ischura posita*, was seen along a tributary to East Wailuanui Stream at Intake K-19 (Station 8). Dragonflies were not particularly abundant, but the endemic Hawaiian giant dragonfly, *Anax strenuus*, was seen at West Wailuanui Stream (Station 11), and the indigenous *Pantala flavescens* was encountered at Honopou Stream below Intakes W-22 and NH-22 (Station 1), at West Wailuanui Stream upstream of Intake K-21 (Station 11), and along an undiverted tributary to Waiokamilo Stream.

The most significant result of the current surveys was the re-confirmation of the ESA-listed *M. pacificum* along Hanehoi Stream in the reach between intakes NH-22 and W-22, as well as in the freely flowing, undiverted reach above intake W-22. The species was previously recorded at this site by the author on 28 January 2008, and again on 1 May 2008, so this appears to be a healthy and persistent population. Its presence will necessitate an ESA consultation for any work undertaken to modify the stream diversions at this site. Although Hanehoi Stream has been slated for full restoration in order to return flows for traditional Native Hawaiian taro cultivation, a substantial amount of its flow was still being diverted at intake W-22 at the time of the most recent survey on 20 May 2019 (Figs. 11, 13, 15), so it is obvious that work to inactivate this intake, as well as intake NH-22 immediately downstream, has not yet commenced.

No observations of *M. pacificum* were obtained at several other sites where the species was previously observed in 2008, these being Honopou Stream (Station 1) and an upper tributary to Huelo Stream (Station 4). At Honopou Stream, the previous record was taken from a reach some distance upstream from intake W-22, which was not regained during the current time-constrained survey that concentrated specifically on the stream reaches adjacent to the intake structures. It is worth noting that in 2008 there were also no sightings or collections of *M. pacificum* at or near the intakes, so this

negative result at that specific site is consistent with previous findings. On the upper Huelo Stream tributary, the visit during the current survey was very brief, and it was not possible to walk any distance down this channel to adequately determine the presence or absence of the species. As such, this negative result from 2019 should be considered provisional. This is also not a site currently proposed for any ditch modification or other construction.

The current surveys also reinforce previous findings to the effect that *M. pacificum* does not seem to occur at points of diversion along the Koolau Ditch system to the east of the Koolau Gap. As can be seen in Figure 3, all records of this species from the area to the east of Keanae have come from the vicinity of the Hana Road, or from the lower gorge of Hanawi Stream to the east of Nahiku. The absence of records from the Koolau Ditch points of diversion and along the adjacent EMI ditch road is not necessarily due to an absence of effort, since other surveys to assess for the presence of *Megalagrion* species occurred in this sector in 1994 and 2001. Instead, it may reflect a true absence of this species along this section of the EMI ditch system, which lies in a wetter section of the mountain than the sites occupied by the species in the Lupi Road sector.

The present surveys also did not produce any additional records of *M. nesiotes*, the other ESA-listed *Megalagrion* species currently known from windward Haleakala. This taxon is currently known from a single population occurring along East Wailua Iki Stream not far above the Hana Road, where it is found along wet, shaded banks at some distance above the stream itself. Although the current surveys provided the opportunity to examine many seeping bedrock walls and other most riparian habitats in the Wailuanui and Waiokamilo catchments which would seem to represent favorable habitat for this species, no sign of it was detected. This supports the current interpretation of *M. nesiotes* as a very rare and localized taxon that occurs as small, widely separated colonies. Despite the negative data from the present efforts, the assumption still remains that other colonies may be present, given the topographic complexity of windward Haleakala and the large number of moist terrestrial habitats available, many of which are difficult for biologists to access.

## Conclusions

The current surveys indicate that the already completed or currently proposed actions to undertake permanent de-activation of points of diversion in the Honopou, Hanehoi, Wailuanui and Waiokamilo stream systems of East Maui should for the most part not produce any impact to ESA-listed *Megalagrion* damselfly species. The one exception is on Hanehoi Stream in the reach between NH-22 and W-22, where a robust population of the ESA-listed *M. pacificum* is present, necessitating some level of ESA consultation with the U. S. Fish and Wildlife Service. Overall, the proposed diversion de-activations should have a net positive effect in regard to habitat restoration for such damselflies and other native stream species.

## Acknowledgments

The field work along streams in East Maui could not have been accomplished without the assistance of Scott Fretz, Lance DeSilva, Keahi Bustamente and Cynthia King from the State of Hawaii's Division of Foresty and Wildlife, as well as Skippy Hau and Glenn Higashi from the state's Division of Aquatic Resources. Access to ditch maintenance roads was generously facilitated by Mark Vaught of the East Maui Irrigation Company.

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# Figures

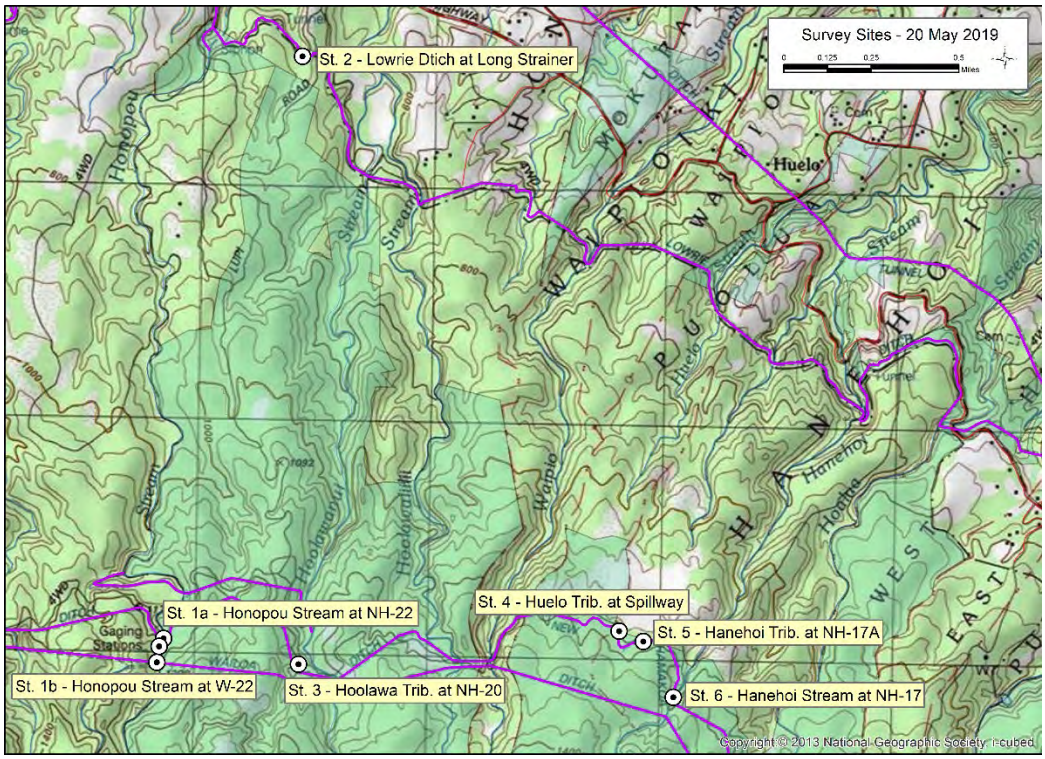


**Fig. 1**. Sites surveyed on the EMI ditch system on 20 May 2019.

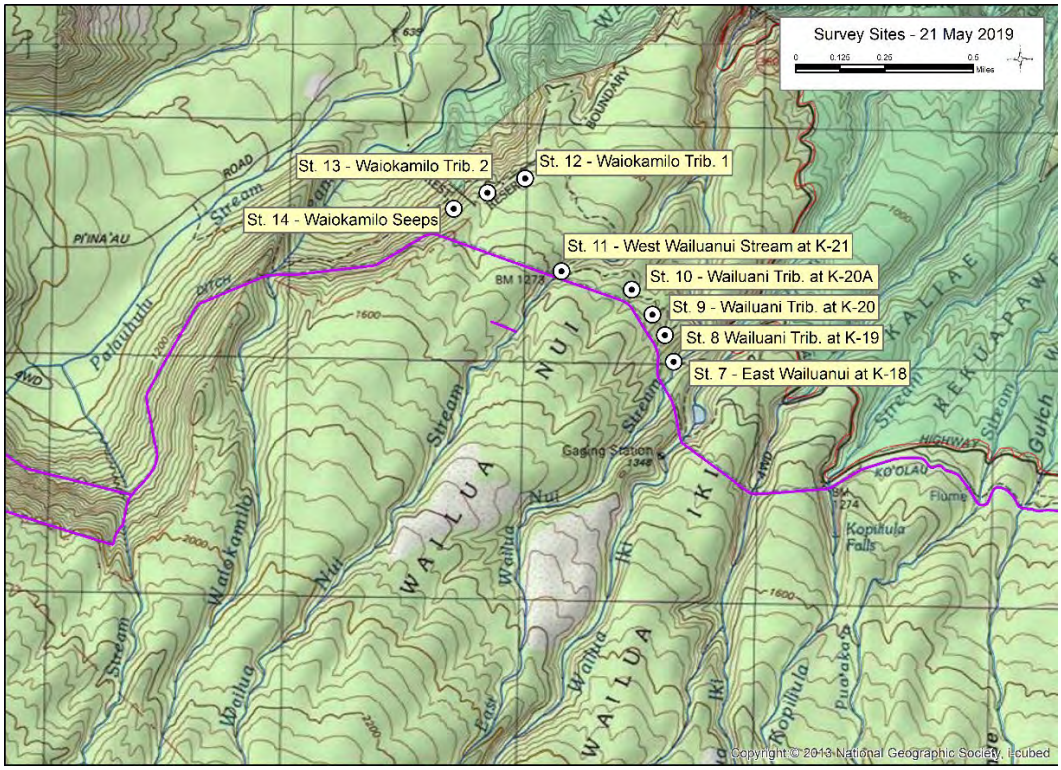


**Fig. 2**. Sites surveyed on the EMI ditch system on 21 May 2019.

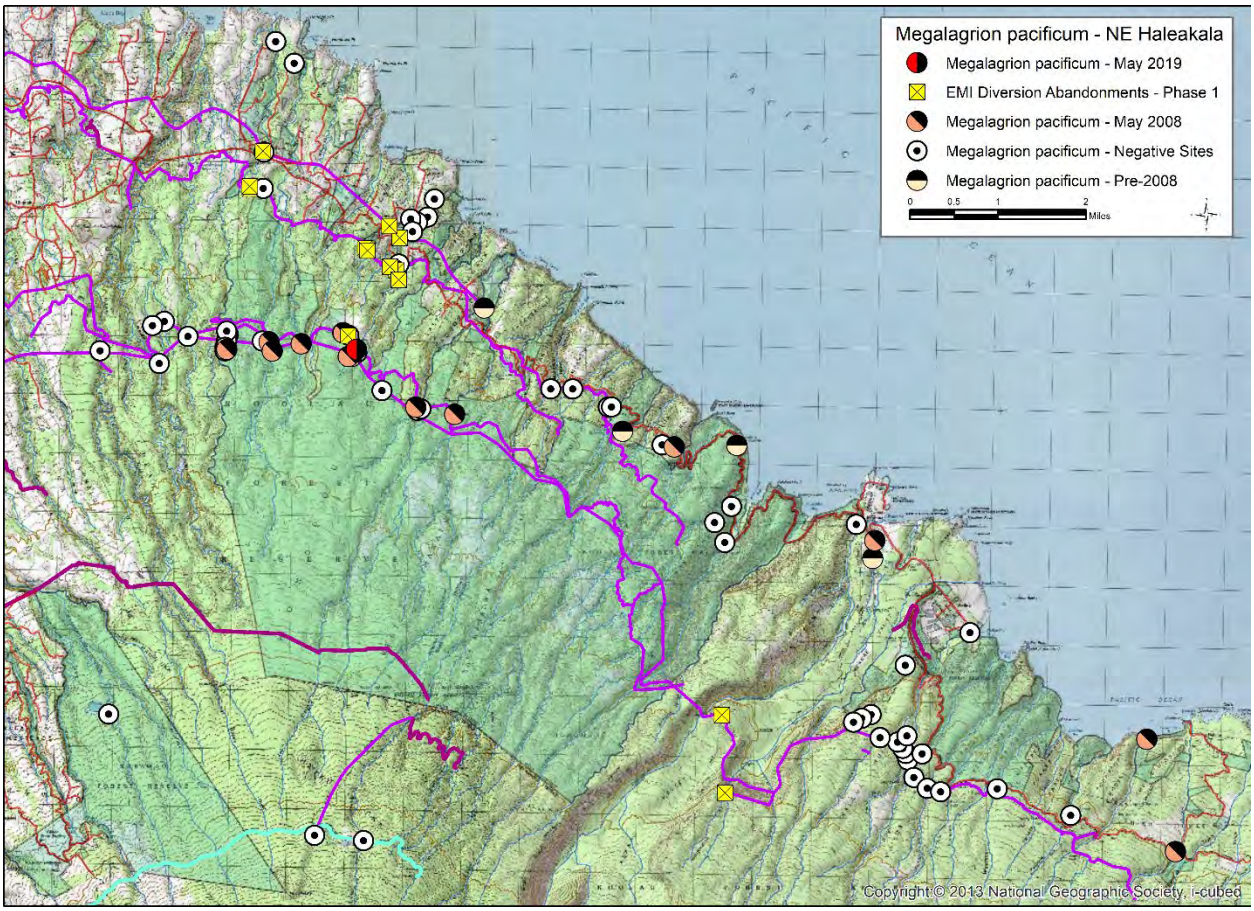


**Fig**. **3**. Documented distribution of *Megalagrion pacificum* on the northeast slope of Haleakala volcano, East Maui, from 1990 to present. Negative sites are those where competent specialists have searched for the species under favorable conditions but recorded no sightings. Purple lines represent the various ditches of the EMI system.

**Fig**. **3**. Station 1a. Honopou Stream looking upstream at New Hamakua Ditch intake NH-22.

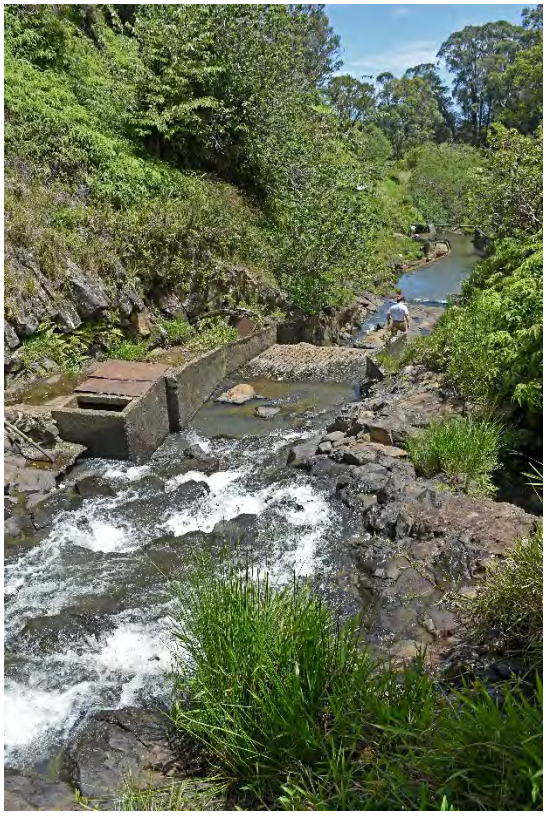

**Fig**. **4**. Station 1b. Honopou Stream looking downstream at Wailoa Ditch intake W-22.

**Fig. 5**. Station 3. West Hoolawanui Stream tributary looking upstream at New Hamakua intake NH-20.

**Fig**. **6**. Station 3. West Hoolawanui Stream tributary looking downstream at New Hamakua intake NH-20.

**Fig**. **7**. Station 4. Tributary to upper Huelo Stream, east of NH-17a, looking downstream.

**Fig**. **8**. New Hamakua Ditch east of Intake NH-17a, showing significant blockage by fallen trees.

**Fig**. **9**. Station 5, New Hamakua Ditch at intake NH-17a, looking upstream across the ditch

**Fig**. **10**. Station 5, New Hamakua Ditch at intake NH-17a, looking downstream along weedy channel.

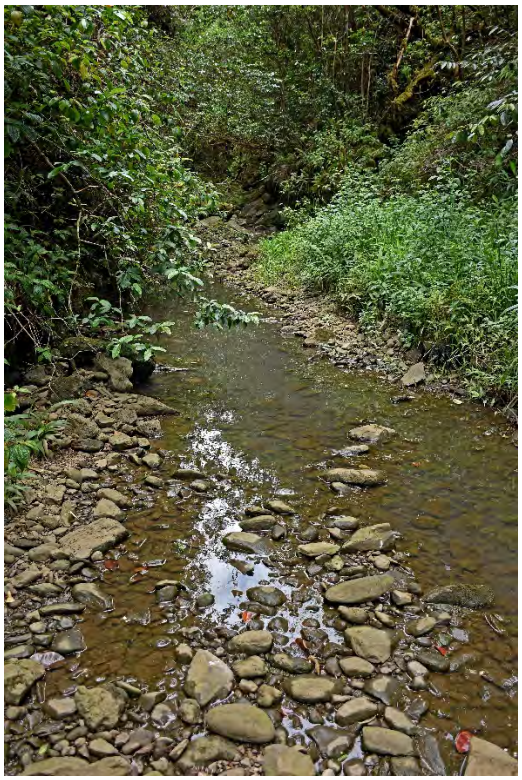

**Fig**. **11**. Station 6a. Hanehoi Stream looking upstream at New Hamakua Ditch intake NH-17, *Megalagrion pacificum* habitat.

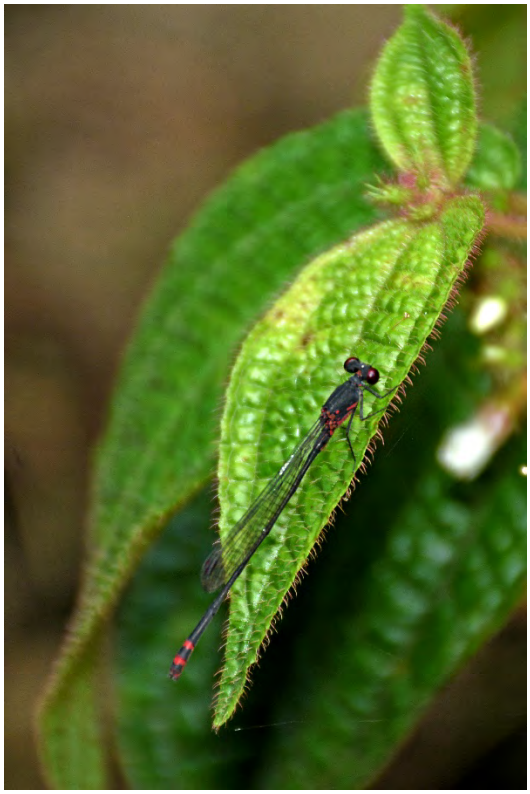

**Fig**. **12**. Station 6a. Hanehoi Stream above New Hamakua Ditch intake NH-17, *Megalagion pacificum* perching beside stream.

**Fig**. **13**. Station 6b. Active Wailua Ditch intake W-18 along Hanehoi Stream.

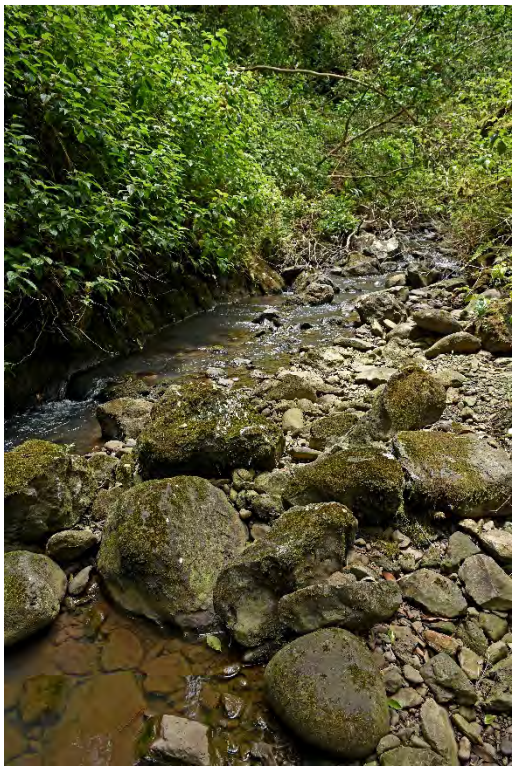

**Fig**. **14**. Station 6b. Hanehoi Stream looking upstream at Wailua Ditch intake W-18.

**Fig**. **15.** Station 6a, Hanehoi Stream looking downstream to New Hamakua Ditch intake NH-17. The stream channel is nearly dry downstream of the concrete weir. All diversion at this site is being accomplished via the Wailoa Ditch intake W-18 further upstream.

**Fig**. **16.** Spillway along New Hamakua Ditch, emptying into a tributary to upper Huelo Stream northeast of New Hamakua Ditch intake N-17a. Note the fallen trees in the ditch, which is not flowing at this point, and missing flash boards along the spillway, indicative of disrepair.

**Fig**. **17.** Station 2, Lowrie Ditch at the Long Strainer and intake L-15, along an eastern tributary to Honopou Stream. The ditch in this area is not flowing, and is heavily overgrown with weeds.

**Fig**. **18.** Station 2, Lowrie Ditch and associated tunnel a short distance east of the Long Strainer and intake L-15.

**Fig**. **19.** Station 2, Standing water along the Lowrie Ditch immediately east and upstream of the Long Strainer and intake L-15. In its current condition this ditch does not appear suitable for water transport. No native damselflies were seen in this area.

**Fig**. **20**. Station 7, East Wailuanui Stream, looking upstream below Koolau Ditch intake K-18.

**Fig**. **21**. Station 7, East Wailuanui Stream, looking downstream below Koolau Ditch intake K-18.

**Fig**. **22**. Station 8, Koolau Ditch at Intake K-19, on a tributary to East Wailuanui Stream.

**Fig**. **23**. Station 8, tributary to East Wailuanui Stream above Koolau Ditch intake K-19.

**Fig**. **24**. Station 9, tributary to East Wailuanui Stream at Koolau Ditch intake K-20.

**Fig**. **25**. Station 10, tributary to East Wailuanui Stream at Koolau Ditch intake K-20a.

**Fig**. **26**. Station 11, West Wailuanui Stream, looking upstream above Koolau Ditch Intake K-21.

**Fig**. **27**. Station 11, West Wailuanui Stream, looking downstream from Koolau Ditch Intake K-21.

**Fig**. **28**. Station 11a, roadside seeps just to the northeast of Koolau Ditch intake K-21, which provided habitat for the native damselfly *Megalagrion hawaiiense*.

**Fig**. **29.** A female of the native damselfly *Megalagrion hawaiiense*, photographed while ovipositing at the base of the seeps shown above.

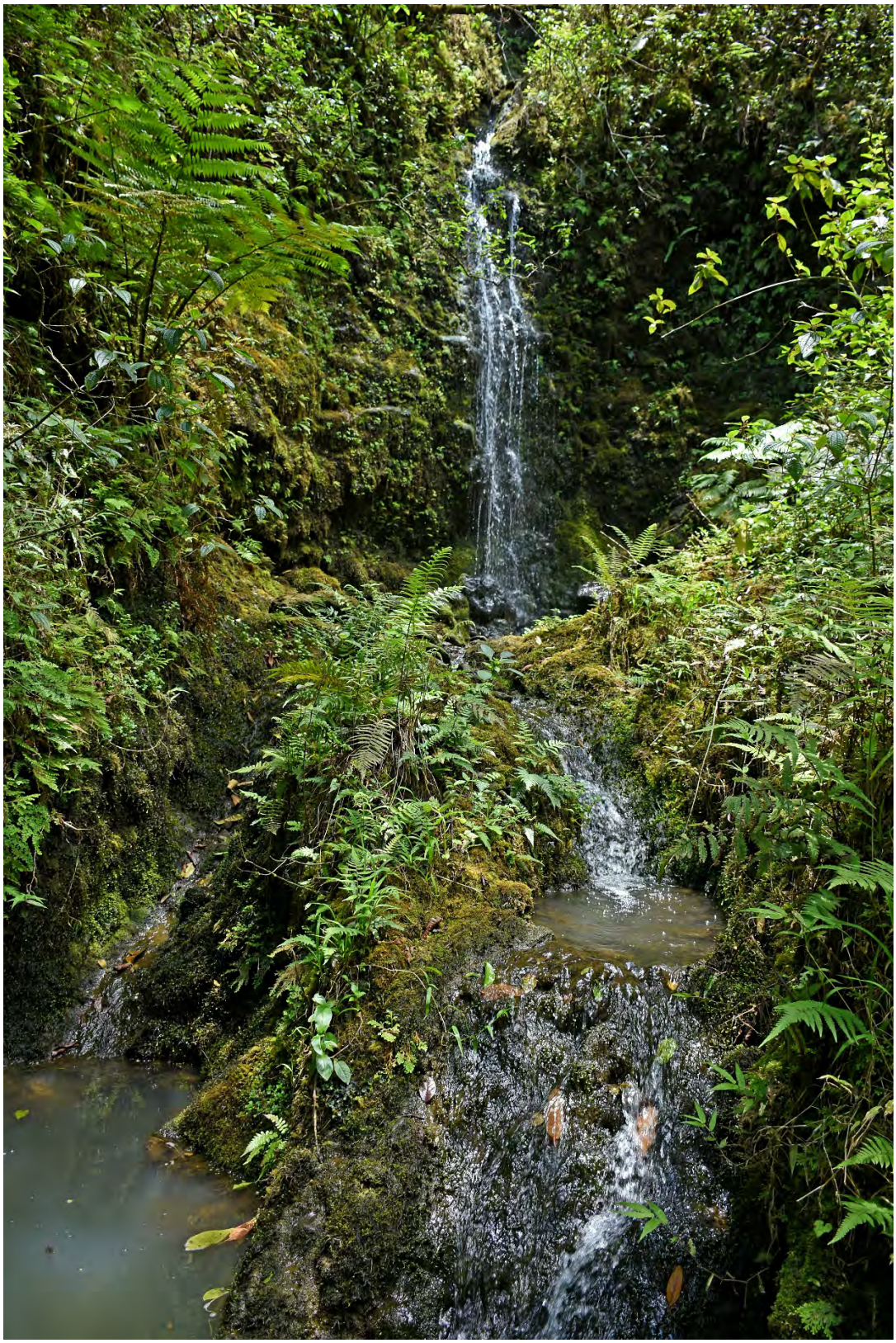

**Fig**. **30.** Station 11, tributary to West Wailua Iki Stream a short distance upstream of Koolau Ditch intake K-21. Although this is a very picturesque habitat, no native damselflies were seen here.