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**Memorandum:**

FROM: Steven Lee Montgomery, Eric Guinther

TO: Jay Morford

DATE: September 25, 2023

SUBJECT: 20 months of data on a Hawaiian damselfly at Hawaiian Memorial Park, Kaneohe



The reason for this memorandum is to inform you that there have been no sightings of damselflies at Hawaiian Memorial Park (HMP) since January of 2023, and to interpret and explain the circumstances.

A population of endangered damselflies, *pinapinao ānuenuē* or blackline Hawaiian damselfly (*Megalagrion nigrohamatum nigrolineatum*), was first noted at a small seep on HMP in 2017. Flow from a dug well and springs eroded a shallow, braided stream channel and water occupied the bed creating a seep stream habitat. The weak-flying adults perch on stream side rocks and vegetation, and regular monitoring of the stream began September 2021, with *AECOS* biologists responsible for monitoring environmental parameters and the team of Dr. Steven Montgomery and Anita Manning monitoring the damselfly population twice-a-month.

Historically known from windward slopes of the Wai‘anae and Ko‘olau mountains from near sea level to over 2400 ft., the damselflies are found now in the headwaters of many streams on the leeward and windward sides of the Ko‘olau Range, those nearest to HMP being streams in the windward valleys of He‘eia, Waikāne, Waiāhole, Maunawili, Mānoa and Kalihi. It is known mostly in portions of streams not occupied by predatory fishes (Williams, 1936; Polhemus & Asquith, 1996, USFWS, 2012).

Counts of damselflies by the *AECOS* team and by Montgomery are summarized in “Figure 13” below, recorded by areas along the seep stream. The table gives results by week number, combining and averaging results for any week in which more than one survey was conducted.

The distribution of adult damselflies is directly a consequence of their larva’s habitat provided by the seep. The adults mate and the females deposit eggs on vegetation at the water surface. On the seep, 3 damselfly adults were sighted per visit, on average. The unmarked adults are quite mobile, so it is possible that adults were counted more than once in a visit. For the upper and lower ends of the seep respectively, the averages were less than 1.

Table 7 presents the results from Sept. 2021 to Dec. 2022 and Table 8 presents the results from mid-December 2022 through April 1, 2023, which are separated from the previous sightings

because they represent over three months and 15+ visits with no sightings of *Megalagrion* anywhere along the stream.

Looking for trends in the data, Figure 13 plots the number of sightings per week as a bar graph and a trend line for the period between September 2021 and September 2022. The trend line is nearly level, indicating that in this period no trend in the counts is apparent, at around 4 sightings per month. The trend line for the entire data set (through the end of April) shows a linear downward trend from 5.4 sightings per week to 0 sightings per week. This trend is thus strongly influenced by the counts of adults observed after September 2022, dropping eventually to zero in December

Whether the decline in the population was sudden or gradual depends upon how the numbers by week are viewed. Figure 13 suggests a stable population through most of 2021-22, but the observation counts range widely from week to week. Starting around week 33 (August 2022), the counts decline through week 38 (September 2022) then remain low through week 49 (December 2022), after which week damselflies are not recorded.

The team has witnessed only three damselfly emergences as they crawled from the water into the air on sticks and stones. During a July 2022 monitoring event, AECOS team members saw a just emerged, tender adult on a bordering rock being dismembered by African big-headed ants (*Pheidole megacephala*) (see photo). It had crawled onto an ant accessible shore rock to molt, but was not capable of flight until new wings and skeleton hardened. It was seized by foraging ant workers, and the photo of ants during their attack represents crucial evidence that reveals the role of shrinking water barriers providing greater access onto the seep surfaces for hunting ants is having a negative impact on the resident population of damselflies. Of all factors evaluated, this increased accessibility for predatory ants to the damselfly's habitat is **indicated as the leading cause of the decrease** in the damselfly population and recent lack of sightings. Ants have been observed all along the seep stream throughout pre-construction monitoring, as well as in prior invertebrate surveys of the property (Montgomery 2017, 2008). Big-headed ants were always common here, often seen drowned, trapped in the surface film.



**Bigheaded ants dismembering young damselfly, July 2022 AECOS photo**

Known to prey on most insects, ants are cited as a “primary threat” factor for the damselfly in the 2011 Listing of Endangered Species (Federal Register 2011), and a serious harm to most native arthropods. Widespread from sea level to 2,000’, *Pheidole* is noted as the cause of extermination for many endemic invertebrates (Zimmerman 1948).

**Relevant ant control case histories:** In 2010 Hawaii wildlife managers, reported the eradication of this invasive ant and unanticipated effects on arthropod and avian communities (Plentovich, et al. 2010). They tested the effects of the formicide Amdro (hydramethylnon) on *Pheidole megacephala*, which was eradicated from the islet, Mokuauia, and was not detected during

2003–2008. The eradication was followed by dynamic compositional changes in the ant community, including the apparent colonization by three other species (*S. geminata*, *Tetramorium bicarinatum* and *Anoplolepis gracilipes*) previously undetected on the islet. One of these, *A. gracilipes*, underwent a rapid range expansion during 2006–2008 which corresponded with reduced seabird nesting success. They concluded that hydramethylnon can be used effectively on islets to eradicate *P. megacephala*. However, ant eradications can have detrimental effects on ecosystems, and the potential for subsequent colonization of sites by other ant species that may be more harmful and more difficult to eradicate needs to be considered. (Plentovich et.al. 2011). It is also possible that the use of any ant pesticide could harm damselflies.

On Australia’s Lord Howe Island in 2013, a work plan that guided the eradication of the invading African big-headed ant notes that Amdro is toxic to aquatic invertebrates, so care was taken to avoid contaminating waterways, and it was applied in dry conditions.

Based on the above studies, control by pesticides of *P. megacephala* would not be feasible at the HMP seep.

Predation by birds on damselfly adults or naiads has not been previously reported (Williams, 1936; Polhemus & Asquith, 1996). However, while Montgomery and Manning observed an emerging damselfly by the flume on May 25, 2022, a White-rumped Shama made repeated passes within a foot of the emerging damselfly, even very close to the observers, so a decision was made to stay until the damselfly could move freely to evade attack. This incident indicates the possibility that avian species might also prey on damselflies.

With regard to effects resulting from climate conditions, Guinther & Montgomery note in a 2023 monitoring memo that:

*“From late December 2022 a series of storms occurred that could have had an impact on the population by increasing stream flow (creating a freshet) accompanied by high winds. Similar conditions occurred in the previous November-December, 2021 (weeks 44 through 51 in Fig. 13) with no appreciable decline in the damselfly population. The period of lowest flows in the seep stream occurred in August-September 2022. If this drought period and consequent reduction in damselfly naiad habitat had a negative impact on naiad survival, a decline in emerging adults would be evident after December 2022. Perhaps telling, but of unknown significance, are the observations of other aquatic fauna in the seep stream. Thiarid snails and diving beetles were first noted in the seep stream in February 2022 and regularly observed through December 2022. Only thiarid snails were observed in January 2023. And no invertebrates of any kind were recorded thereafter through March 2023.”*

*“The cause of the decline in the damselfly population in 2023 is unknown. Various factors—minimal stream flow in August-September, high stream flow in November-December, a period of high winds, or predation by other insects—can only be considered speculative at this time.”*

This HMP population may be going through a narrowing of local population numbers due to a reduction in seep surface. It should be kept in mind that the young aquatic stages of the species take 3 or 4 months to feed and mature, and adults live about 1 month more, so it is possible there are a few individuals still present. The statistical chances of a surveyor being on-site at the specific location and at the specific time when those relict individuals would be at the seep are very slim. However, it is still possible that a sighting may be made, so continued monitoring is needed to know their status.

Two translocation attempts from the lowland O'ahu Moanalua stream of another damselfly, *M. xanthomelas*, to new sites did not succeed.

During the dry period to improve the habitat, water was added to the old HMP well, which briefly raised the level to promote seepage flow into the upper seep sector.

Periods of extreme low water levels in this seep are a direct result of drought conditions. Climate projections are for drier and warmer years ahead that most probably will further reduce the suitability of a presently marginal aquatic habitat when compared to upland Ko'olau perennial streams with a damselfly population estimated at 2000 (USFWS, 2012).

Table 7. Combined pinapinao anuenue sightings for 2021-2022.

Month and WEEK No.	Monitoring Area A	Monitoring Area B1	Monitoring Area B2	Monitoring Area C	WEEK COUNT				
2021 SEP 38	1	6	1	2	10				
39	0	3	2	3	7.0*†				
OCT 42	0	4	0	0	3.5*†				
43	0	0	1	0	1				
NOV 44	0	2	2	0	4				
46	2	4	2	3	6.5*				
47	0	0	0	0	0				
DEC 48	0	1	0	0	1				
49	1	8	1	0	10				
50	0	0	3	0	3				
51	0	1	4	0	5				
2022 JAN 1	0	3	0	0	3.0*				
2	0	3	0	0	3				
3	0	2	0	3	5				
4	0	0	1	0	1				
FEB 5	0	2	3	1	5				
6	0	0	0	0	0				
7	0	3	1	0	4				
8	0	0	3	0	3				
MAR 9	1	4	0	1	6				
10	0	0	0	1	1				
11	1	5	0	2	8				
12	0	0	0	0	0				
APR 13	0	4	2	1	4.5*				
15	0	0	0	0	0				
16	0	3	0	1	4				
MAY 18	0	3	0	2	3.0*				
19	0	0	0	0	0				
20	0	3	1	1	5				
21	3	0	1	1	5				
JUN 22	0	4	3	1	8				
23	0	0	2	0	2				
24	1	7	1	0	9				
25	0	0	2	0	2				
JLY 26	0	6	3	0	9				
27	0	0	2	0	2				
28	0	2	2	1	5				
29	0	0	2	0	2				
JLY 30	0	5	2	1	8				
AUG 31	0	1	1	0	2				
32	0	4	5	0	9				
33	0	8	2	0	6.0*†				
34	0	3	1	0	4				
35	0/0	2/1	2/1	1/0	3.5*				
SEP 36	0/0	4/4	0/1	0/0	4.5*				
37	0	0	0	0	0				
38	0	3	0	0	3				
39	0	0	1	0	1				
OCT 40	0	0	0	0	0				
42	0	0	0	0	0.0*				
43	0	0	0	1	0.5*				
NOV 44	0	0	0	0	0				
45	0	0	0	0	0.0*				
46	0	1	0	0	1				
47	0	2	0	2	2.0*				
DEC 48	0	2	2	2	3.0*				
49	0	1	0	0	1				
50	0	0	0	0	0.0*				
<b>Mean Count</b>	<b>0.17</b>	<b>0.09</b>	<b>2.82</b>	<b>0.64</b>	<b>0.90</b>	<b>1.03</b>	<b>0.70</b>	<b>0.09</b>	2021-22

\* Value is a mean of the two surveys conducted in the same week.

† Both surveys conducted on the same day.

Mean Count is for 2021-2022 surveys only.

Shaded columns = AECOS data; unshaded columns = SLM surveys.

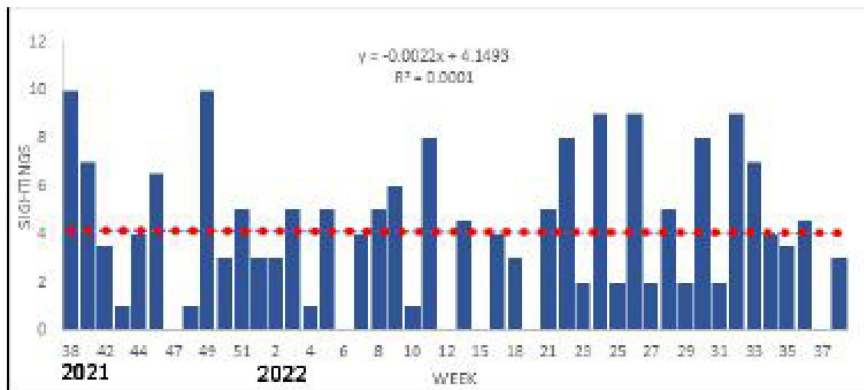


Figure 13. Bar graph for *pinapinao* sightings made between September 2021 and September 2022 (combined AECOS and SLM data).

Table 8. Combined *pinapinao* *ánuenue* sightings for 2023.

Month and WEEK No.	Monitoring Area A		Monitoring Area B1		Monitoring Area B2		Monitoring Area C		WEEK COUNT
2022 DEC 50	0	0	0	0	0	0	0	0	0.0 † †
52	0	0	0	0	0	0	0	0	0.0 *
2023 JAN 01	0		0		0		0		0
02		0		0		0		0	0.0 *
03	0		0		0		0		0
04	0		0		0		0		0
FEB 05	0	0	0	0	0	0	0	0	0.0 † †
06	0		0		0		0		0
07	0		0		0		0		0
08	0		0		0		0		0
MAR 09	0	0	0	0	0	0	0	0	0
10	0		0		0		0		0
11	0	0	0	0	0	0	0	0	0.0 † †
12	0		0		0		0		0
APR 13	0		0		0		0		0

\* Value is a mean of the two surveys conducted in the same week.

† Both surveys conducted on the same day.

Shaded columns = AECOS data; unshaded columns = SLM surveys.

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