

## The Orangeblack Hawaiian Damselfly, *Megalagrion xanthomelas* (Odonata: Coenagrionidae): Clarifying the Current Range of a Threatened Species<sup>1</sup>

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### Introduction

The Orangeblack Hawaiian Damselfly, *Megalagrion xanthomelas* Selys-Longchamps, formerly occurred in lowland aquatic habitats throughout all the high Hawaiian Islands. Although common at the turn of the century, the species began to experience a progressive decline after World War II, and by the early 1990s had not been seen on Oahu for over 20 years. This fact, coupled with the extensive alteration of lowland habitats in which the species formerly bred, led Polhemus (1993) to conclude that the species was probably extirpated on Oahu when he reviewed the conservation status of *Megalagrion* species for the U. S. Fish and Wildlife Service (USFWS). Based on this assessment, plus the apparent extirpation of the species on Kauai and Maui as well, USFWS (1994) proposed that *M. xanthomelas* be listed as a Threatened species and given protection under the Endangered Species Act.

Given this, it was of great interest when a remnant population of *M. xanthomelas* was discovered in the course of an environmental survey conducted by personnel from the Hawaii Biological Survey in March 1994 at the Tripler Army Medical Center (TAMC), on the outskirts of Honolulu. This population, so far as is known, is the last remaining colony of *M. xanthomelas* on Oahu, and thus a priority target for conservation efforts. The existence of the population was noted in a report to the R.W. Towill Corporation of Honolulu (Evenhuis & Cowie 1994); this report also concluded that the insects were confined to a small gully near the greenhouse at the lower end of the TAMC site, in an area that had the potential for being impacted by proposed construction activities further upslope. It was recommended that in order to ensure the continued survival of the TAMC *M. xanthomelas* colony the population should be relocated to a nearby site that would not be subject to construction impacts or other activities taking place on the TAMC grounds, a task that has recently been accomplished through the construction of an artificial refugium.

In order to properly design the refugium for the TAMC population, it was necessary to conduct a detailed investigation of the biology of *M. xanthomelas*, which was poorly known at the time. This involved both detailed studies at TAMC (to be reported in a separate publication), and investigations at sites on other islands where populations of *M. xanthomelas* were still known to persist. This report details the results of those surveys, providing a statewide conservation assessment of this increasingly rare species.

### Taxonomy and Historic Distribution of *Megalagrion xanthomelas*

*Megalagrion xanthomelas* was described by Selys-Longchamps (1876) based on specimens collected by G.F. Matthew of the Royal Navy, and labelled "Sandwich Islands", with no specific island within the group noted on the labels. The location of Selys-Longchamps' types is not currently known, although they may be in the Koninklijk

Belgisch Instituut voor Natuurwetenschappen, in Brussels. The species has not been confused with others since its original description, thus its taxonomic history is relatively simple and devoid of synonyms.

The original distribution of *M. xanthomelas* within the Hawaiian Islands is a matter of some speculation. It seems unlikely that the species ever inhabited the small, dry island of Kahoolawe, and its presence on Kauai is open to question, although a single specimen is present from nearby Nihoa (see below). Perkins (1899) stated that *M. xanthomelas* "Probably occurs all over the islands", despite the fact that he lacked any collections from Kauai and Lanai. Keeney (1917), probably following Perkins' statement, listed *M. xanthomelas* from Oahu, Molokai, Maui, Hawaii, Kauai and Lanai, even though once again there were apparently no specimens at hand supporting the latter 2 records. It was only in 1993 that specimens were finally captured on Lanai (Polhemus 1993); and to date the species has never been taken on Kauai.

The ecology of *M. xanthomelas* was discussed anecdotally by Williams (1936), who also illustrated the immatures. They appear to have formerly bred in impounded sections of lowland streams, and in both natural and artificial ponds. The ability of this species to exploit artificial habitats was noted by Perkins (1913), who observed that *M. xanthomelas* was:

"a common insect in Honolulu gardens and in lowland districts generally, not usually partial to the mountains, though in the Kona district of Hawaii it is common about stagnant pools up to an elevation of about 3000 feet. It is very numerous under conditions changed from the natural; perhaps it now finds more numerous breeding places, and a more abundant prey in the numerous insects that have been introduced by man in the region it frequents."

Williams (1936) also noted that *xanthomelas* bred abundantly in sugar plantation reservoirs at Waianae; Zimmerman (1948), by contrast, remarked that the introduction of *Gambusia* topminnows "has changed the lowland situation considerably in recent years however, and the species is much less abundant than formerly."

The decline in populations of *M. xanthomelas* noted by Zimmerman in the years after World War II has continued to the present day. The species is now apparently extirpated on Maui, with no records from that island for the last hundred years, and reduced to a single known population on Oahu (at TAMC). Molokai is known to support 4 populations and the species is abundant in artificial golf course ponds on Lanai, although elsewhere on that island it retains only a tenuous foothold in small remnants of its former natural habitat. Only on Hawaii Island is the species still truly widespread, being commonly found in the coastal wetlands of the Puna, Kau and Kona districts.

In the sections below, the current distribution of *M. xanthomelas* is discussed on a island by island basis. The terminology used to describe aquatic ecosystems follow Polhemus *et al.* (1992).

### Nihoa

A single specimen of *M. xanthomelas* is in the Bishop Museum (BPBM) bearing Nihoa label, collected by L.D. Tuthill on 16 August 1947. No specific locality is given but the specimen was probably collected along the margin of Hahulu Lake, a permanent mirrorlike pond fed by basal spring outflows, or from one of the perched springs that occur at Kaali and in Waiokamaio Gulch.

## Dan Polhemus Orange

unsuccessful. Based on these results, it seems possible that *M. xanthomelas* may have been locally extirpated on Maui.

#### Hawaii (Big Island) Ninole Springs

Scattered populations of *M. xanthomelas* are known from coastal wetlands in Puna, Kau and North Kona on Big Island, where limnetic groundwater percolates seaward and mixes with the inland percolating marine water table to form horizontally stratified mixohaline systems. The largest of these coastal *M. xanthomelas* populations is found in a set of limnocrenes, rheocrenes, and mixohaline marshes located at Ninole, Kau, where downslope subsurface percolation from the Ninole Hill drainages emerges just above sea level at the mouth of Ninole Stream. This is the second largest basal spring complex on the island of Hawaii (the largest being Waiakea Pond at Hilo), discharging over 20 million gallons per day in 1946 (Stearns & Macdonald, 1946), although this flow may have been subsequently modified by withdrawals from wells to irrigate sugar cane fields up-lope. The water originates from lava tubes in the Kau volcanic series, and represents the subterranean outflow from ancient valleys in the nearby Ninole Hills that were filled by subaerial eruptions from Mauna Loa. Due to its origination in catchments upslope the water is quite cold, with an emergent temperature of 19 °C. This groundwater surfaces along the inland sides of coastal lava basins that have some degree of connection to the sea, creating horizontally stratified mixohaline systems with a zone of freshwater marsh along their inner margins. Similar basal spring wetlands are found at several other points along the Kau coast, including Punaluu, the mouth of Hilea Stream at Hawa Bay, Hawa Springs, and Whittington Beach Park.

The Ninole Spring wetland complex contains an extensive set of limnetic to mixohaline marshes, ponds and creeks lying at the stream mouth and in the area directly to the east, between the Sea Mountain golf course parking lot and the lava coastline. Numerous cold freshwater springs emerge just inland of the coast at the base of an *a*'a flow, some flowing directly into tidepools, others feeding large ponds and sloughs. One large pond with thick beds of watercress along its margins occupies a lava basin immediately east of the stream mouth, and is separated from the sea by a wall of lava ca. 3 m high, which large waves occasionally overtop. A second, even larger pond lies further to the east, in a basin just above sea level, and enters the ocean via a swift freshwater creek ca. 1 m wide and 15 cm deep. The inland margins of both these ponds grade into marshes dominated by tules (*Schroberia sp.*) and *Samolus*, similar marshes are also present in the area between the ponds, in association with smaller spring outflows. The eastern pond also contains water hyacinth (*Eichornia crassipes*) along its inland margin.

Surveys undertaken during early May 1994 found *Megalagrion xanthomelas* to be abundant at Ninole Springs, breeding in all suitable habitats. Numerous mating pairs were observed, and many newly emerged adults were seen along the margins of the western-most pond. A mating pair was also captured above the standing pool formed behind the cobble bar at the mouth of the stream itself. In addition, the introduced damselflies *Enallagma civile* and *Isonura ramburi* were present along the margins of the eastern pond, especially in seaward areas exposed to the wind, but *M. xanthomelas* was clearly the dominant damselfly species across the entire Ninole system. In general the introduced damselflies seemed more abundant in open areas, while *M. xanthomelas* flew amid the

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shelter of vegetation along the slough channels, which were difficult to investigate, being heavily vegetated and often over 1 m in depth. The large dragonflies *Anax junius* and *Pantala flavescens* were also seen throughout the Ninole area.

The salinity of the aquatic features at Ninole Springs varied from limnetic (less than 0.7 ppt) at the outflows to fully euhaline (at least 30 ppt) at the shore, with all degrees of intermediate salinity encountered throughout the ponds and marshes. It is clear from other investigations on Molokai (see previous section) that *M. xanthomelas* can tolerate salinities of at least 2 ppt, thus it is able to breed along much of the inland margin of the Ninole wetland system.

The estuarine marshes and limnocrenes at Ninole Springs and other coastal wetlands in Kau provide extensive breeding habitats for *M. xanthomelas* that are not currently duplicated on the other high islands, although similar systems may once have existed at Pearl Harbor on Oahu prior to its urban development. Throughout such coastal situations, both here and in North Kona, *M. xanthomelas* is typically found in company with the alien *Isonura ramburi* and *Enallagma civile*, but the competitive interactions among these species, if any, do not seem to preclude the continued presence of *M. xanthomelas* at these sites.

#### Hilea

A coastal wetland similar in form and origin to that seen at Ninole but of smaller extent occurs at the mouth of Hilea Stream, approximately one mile to the southwest on the opposite (western) side of an intervening lava flow. The habitat consists of several elements, beginning with a long, deep mixohaline pool at the mouth of the stream channel, which runs parallel to the base of the lava flow. This pool is separated from the sea by a cobble bar that is occasionally overtopped by high swells, and experiences a weak tidal flux. No damselflies were seen along this pool. West of the stream mouth are several small limnetic ponds bordered with sedges, grasses, and *Homoloma*; these ponds supported *Megalagrion xanthomelas*, *Enallagma civile*, *Isonura ramburi*, *Anax junius*, *Pantala flavescens*, and *Tramea lacerata*. Even further to the west is a large basin, connecting directly to the sea via a narrow mouth, but with a zone of balustrades at the back, bordered even further inland by an extensive, apparently limnetic marsh thickly overgrown with tall grasses. No damselflies were seen at this latter basin, but it seems likely that *M. xanthomelas* may occur in the marsh.

When this site was visited on 4 June 1994, water was being pumped from the western marsh by squatters, who were using it to irrigate small taro fields. One of these squatters claimed that the mouth of Hilea Gulch previously consisted of a large, swampy estuary, but that a major flood 4 or 5 years earlier had washed in a large amount of sediment, producing the current configuration.

#### Kauai

##### Hawa Springs

This habitat consists of a small limnetic spring outflow emerging at the base of an eroded lava flow, and flowing into a linked series of progressively more saline ponds scattered along a sinuate depression behind the shoreline. The overall impression is one of an interrupted tidal creek, bordered by grasses and sedges. During a survey on 4 June 1994 the limnetic ponds near the head of this system supported populations of *Megalagrion xanthomelas* and *Anax junius*; no introduced damselflies were seen. The area appears to be in a relatively natural condition, and does not appear to be frequently visited.

Status: Endangered