THESIS

# DIET MATTERS IN THE GROWTH OF CAPTIVE AFRICAN WHITE-SPOTTED ASSASSIN BUG *PLATYMERIS BIGUTTATUS* (HEMIPTERA: REDUVIIDAE)

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In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Spring 2020

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ABSTRACT

DIET MATTERS IN THE GROWTH OF CAPTIVE AFRICAN WHITE-SPOTTED ASSASSIN BUG *PLATYMERIS BIGUTTATUS* (HEMIPTERA: REDUVIIDAE)

The African white-spotted assassin bug, *Platymeris biguttatus* (L. 1767) (AWSAB) is a large bodied true bug, popular in both zoo and hobbyist living collections. The popularity of this species can be attributed to its high visibility, large colony size, and that reproduction occurs readily in captivity, traits that are uncommon for predacious arthropods. While colonies of AWSAB have been commonly kept in laboratories, zoos, and museum collections for decades, little research has been published describing the impact different prey species have on growth and survival in captivity. Due to the popularity of AWSAB as display animals, determining the optimal methods for captive rearing of AWSAB is crucial for long-term maintenance. My study focused on rearing AWSAB on different prey species and recording survival and growth rate (GR) of captive-bred offspring. African white-spotted assassin bug eggs were collected from mated females and hatched separately. Nymphs were kept individually and fed one of seven diets (n=210): crickets (*Acheta domesticus* L.) exclusively, Dubia cockroaches (*Blaptica dubia* Serville) exclusively, yellow mealworm larvae (*Tenebrio molitor* L.) exclusively, or a combination of these species. The number of days spent by individuals in each instar was recorded, as well as the total number of days lived. Results indicate that the species of prey offered influences the GR, with individuals given multiple species of prey reaching maturity faster. Therefore, steps should be taken to provide colonies of AWSAB a mixture of crickets,

cockroaches, and mealworms instead of a diet exclusively of one species. If only one species of prey can be offered, it is best to offer cockroaches instead of crickets or mealworms exclusively. Survival may also be influenced by diet, with further research needed.

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# CHAPTER 1. DIET MATTERS IN THE GROWTH OF CAPTIVE AFRICAN WHITE-SPOTTED ASSASSIN BUG, *PLATYMERIS BIGUTTATUS* (HEMIPTERA: REDUVIIDAE)

**Introduction**

Arthropods are a major attraction to zoos across the world and serve as an engaging pedagogical tool for concepts in conservation, entomology, and scientific research (Saul-Gershenz 2009). Large predacious species are most popular, with professional living displays often including tarantulas, scorpions, mantids, and various highly visible spiders such as black widows (Saul-Gershenz 2009, McMonigle 2011). Insects and other arthropods provide opportunities to educate the public, oftentimes arresting or reversing fears of species such as spiders (Davey 1991, Syzmanski and O'Donohue 1995, Davey 1994, Cranshaw 2006, Rinck and Becker 2007, Gerdes et al. 2009). Furthermore, live arthropods are an excellent resource to educators because they provide many opportunities for student education and are especially influential on younger learners (Matthews et al. 1997). There is evidence that while the use of either live or preserved invertebrate specimens in a lesson may boost understanding of the material, the inclusion of live specimens has long-term effects on changes in attitudes towards the animals (Sherwood et al. 1989). Interacting with live arthropods is an effective way to stimulate science and inquiry-based learning, which is both important and popular in current pedagogy (Melber 2003, Puntambekar and Kolodner 2005, McDonald and Songer 2008, Golick et al. 2010).

While many zoos spend considerable time and money providing exact diets for their vertebrates, less thought is spent on the diets of predacious arthropods. Most often, insectivorous arthropods are fed a consistent diet of house crickets (*Acheta domesticus* L.) with little to no other prey offered. These crickets are often purchased in bulk from wholesale suppliers and may be 'gut loaded' by feeding the insects special diets (Bernard et al 1997, Finke 2015). The contents of the diet offered to feeder insects significantly influences the nutrients available after consumption (Finke 2015). In an artificial system like those present in captivity, diet is especially important. Diets low in variety have been shown to cause lower survivorship in arthropods (Uetz et al, 1992). It has been shown, for example, that the development, reproduction, and survival of larvae can be significantly influenced by the type of prey offered to the Transverse ladybird beetle, *Coccinella transversalis* (F.) (Omkar 2004). Spiders offered single-species diets have lower fitness and overall survival, and spiders offered only one type of prey can develop a preference for that prey (Toft and Wise 1999, Pekar and Cardenas 2015). Diet quality and quantity has also been shown to influence mate selection and time to maturation in spiders (Hebets et al. 2008).

The African white-spotted assassin bug, *Platymeris biguttatus* (L. 1767) (AWSAB) is a large bodied true bug, popular in both zoo and hobbyist collections (*Platymeris biguttatus*, n.d.) (Figure 1).

Figure 1. A female African white-spotted assassin bug, *Platymeris biguttatus*, a popular display animal in living collections. Photograph: Holmes 2018.

The popularity of this species can be attributed to its high visibility and large size, and because it lives communally and reproduces readily in captivity, traits that are uncommon for predacious arthropods. While colonies of AWSAB have been commonly kept in laboratories, zoos, and museum collections for decades, little research has been published describing the role different prey species has in growth and survival in culture (McMonigle 2015). Despite their popularity as display insects, only four studies have been published. The first paper was published in 1967 and describes experiments using nymphs reared in captivity, including the role humidity and temperature plays in hatch rate, the influence of feeding frequency on growth rate of nymphs, and the influence of communal versus solitary rearing on development (Eluwa 1967). The second paper describes the morphological attributes of this species at different nymphal stages in a laboratory setting (Li and Cai, 2010), while the third proposes the potential native range of the species based on specimens in museum collections from around the world (Chlond et al., 2015). Finally, a study exploring the genetic pathways used to determine pigmentation in *P. biguttatus* was published in 2019 (Zhang 2019). Additionally, a short two-page observational paper was also published by Edwards (1982) on his experience keeping an individual specimen that had been found at the Gatwick Airport in London, England.

Little information is available on the behavior or natural history of AWSAB other than two caresheets (Housing *Platymeris biguttatus* n.d., Sherva 2018) and a brief inclusion by McMonigle (2012, 2015). The only information in common is that AWSAB is of African origin, will accept crickets and mealworms as prey in captivity, and finally that eggs will only develop in moist substrate.

The objective of my study was to determine the optimal diet of the AWSAB in captivity and examine if offering a variety of different prey species from eclosion to adult influences growth and survival. African white-spotted assassin bugs were reared from eclosion to adulthood using the treatments presented in Table 1.

Table 1. The species of prey offered to African White Spotted Assassin Bug (*Platymeris biguttatus* L.) nymphs in seven treatments. Crickets and cockroaches were obtained from the same source throughout the experiment, whereas a colony of yellow meal worm was reared on-site. C=European house crickets, R= Dubia cockroaches, M= yellow mealworm larva.

| **Treatment** | **Prey Species Offered** |
|---|---|
| **C** | European house crickets (*Acheta domesticus* L.) |
| **R** | Dubia cockroaches (*Blaptica dubia* Serville) |
| **M** | Yellow mealworm larva (*Tenebrio molitor* L.) |
| **CR** | Crickets and cockroaches |
| **CM** | Crickets and mealworm larva |
| **RM** | Cockroaches and mealworm larva |
| **CRM** | Crickets, cockroaches, and mealworm larva |

Specifically, the follow questions were examined:

**Survival:** Does a diet comprised of multiple prey species result in a higher rate of survival of AWSAB nymphs to adulthood?

**Growth:** Do individual AWSAB nymphs reared on a single prey diet take longer to mature compared to a multi-prey diet? Do individuals reared exclusively on a single prey diet grow at a different rate compared to those reared on multiple prey?

## Methods and Materials

*Rearing AWSAB:*

On 11 April 2018, eleven male and eight female adult AWSAB were obtained through the Butterfly Pavilion and Insect Center, West 104th Ave., Westminster, Colorado along with ten males and thirteen females from the Denver Zoo, Steele St., Denver, Colorado. On 24 April 2018, eleven males and seven females were obtained through the exotic animal supplier Reptile Rapture, Monona Dr., Monona, Wisconsin. Sex was determined using the identification techniques described in Li et al (2010) and McMonigle (2012), and adults were separated into male (M)/female (F) pairs and randomly assigned to seven treatments (Table 1). Adults were fed once per week on the diet determined by their treatment and kept in plastic containers on sand in a Controlled Environments Limited Model E15 controlled chamber with a 14-10 light/dark cycle at 25°C.

Eggs laid by individual females were placed individually in 7-dram vials with damp coconut fiber (Figure 2).

Figure 2. A single *Platymeris biguttatus* egg deposited into damp coconut coir in a 7 dram vial. Photograph: Holmes 2018.

These vials were kept in the same chamber as the adults (14-10 light/dark cycle at 25°C). The date the eggs were placed in the damp substrate, along with the date of hatching, was recorded. Nymphs were assigned to treatments as they hatched so that each treatment was composed of 35 AWSAB nymphs.

At the beginning of the experiment, nymphs were offered prey three times per week in the same 7-dram vials they were hatched in. However, this was quickly reduced to once per week as nymphs were frequently not attacking the prey more than once per week and noticeable loss of nymphs occurred due to predation from crickets and cockroaches. By the 3rd instar, the 7-dram vials did not provide adequate space, and there were problems with molting and predation from the feeder insects. Therefore, all surviving nymphs were transferred into 5-ounce (141.7 grams) F-K brand extra-large condiment cups with pin holes in the lids. Each container had 5 holes in the lid, a 2 cm layer of EcoEarth coconut fiber, and a piece of Michael's brand plastic plant to hide on. Due to a severe loss from predation, the C and R treatments were restarted, and these nymphs were reared exclusively in the condiment cup containers.

*Rearing prey:*

Crickets were obtained through the Scales 'n Tails, 3645 S College Ave #6, Fort Collins, CO 80525. They were kept in a medium Lee's Kritter Keeper, San Marcos, CA, plastic aquarium style container and offered cardboard egg cartons as climbing material. The crickets were fed a diet of Cricket Bites by Nature Zone, Chico, CA, a gel that contains sugars, amino acids, and vitamins, offered ad libitum. Organic chicken feed was offered freely until a mold outbreak made it no longer feasible to do so. The number of crickets was restocked weekly from Scales 'n Tails. Crickets from this store all come from the same source and are fed the gel diet listed above, as well as vegetable scraps including carrots, lettuce hearts, and kale ribs. Only the gel was offered during the experiment. Crickets were fed to the assassin bugs either directly from the pet store, or after spending 24 hours in a controlled chamber at 25°C.

Dubia cockroaches were obtained on 15 February 2018 from Scales 'n Tails. 30 large (within two instars of maturity and adults) cockroaches, along with approximately one dozen first instar nymphs, were added to a large plastic tub with ventilation and an under-tank heater. This colony was offered newspaper as a substrate and cardboard egg cartons as climbing material. The diet consisted of Cricket Bites by Nature Zone, offered ad libitum. Organic chicken feed was offered freely until a mold outbreak made it no longer feasible. It became apparent that the colony needed to be restocked using Scales 'n Tails cockroaches to provide sufficient suitably sized cockroaches. Cockroaches ranging in size from 1 cm to 2 cm were purchased twice a month and kept in a controlled chamber at 25°C. Cockroaches from this source were fed the same diet as the crickets while at the store.

A colony of yellow mealworms was obtained through the CSU Bug Zoo on 16 February 2018. They were maintained on several inches of organic chicken feed with free access to Cricket Bites by Nature Zone. This colony was kept in the same chamber as the crickets, cockroaches, and assassin bugs.

*Experiments:*

Adult AWSAB were separated into male/female (M/F) pairs and randomly sorted into groups within each treatment. The mass of each adult was recorded weekly on a Sartorius Basic by Sercom scale and used to calculate the amount of prey to offer weekly. My original intent was to offer 80% of the adult mass as prey. This was difficult to maintain, however, due to the extreme size difference between mealworms and adult cockroaches. Therefore, the treatments that received cockroaches consistently received >80% of their mass in prey and the treatments that received mealworms received <80% of their mass in prey. This is because a single adult cockroach has a higher mass than two adult assassin bugs, and the number of mealworms needed to make up 80% of the assassins' mass was impractically too large.

Eggs were collected from each M/F pair at the end of each week for four weeks. Sand was chosen as a substrate to increase visibility of eggs, making them easier to collect (Figure 3).

Figure 3. A clutch of *Platymeris biguttatus* eggs. Eggs are laid individually beneath loose substrate and do not develop until moist. Keeping adults on sand allows for easy retrieval and identification of eggs. Photograph: Holmes 2018

The number of eggs laid weekly by each pair in all treatments was recorded, and eggs were placed in 7-dram vials. After the first four weeks, it was discovered that females deposit most of their eggs much deeper in the sand than the previous literature indicated (McMonigle 2012). Through experience and anecdotal evidence from other zookeepers, it was thought that females oviposit relatively close to the surface (approximately 1 cm). However, a shifted container happened to expose many eggs, revealing that most eggs are laid at least 2 to 4 cm beneath the surface (Figure 4).

Figure 4. An adult female *Platymeris biguttatus* burying her abdomen in loose sand to oviposit her eggs individually. Eggs are laid up to 4 cm below the surface. Photograph: Holmes 2018

Once this discovery was made, the entire substrate was gently combed for eggs in all containers, providing hundreds of additional eggs. After this event, the substrate was checked more thoroughly for the rest of the experiment.

Nymphs were hatched from eggs collected in March 2018, and randomly assigned into one of seven treatments, with 35 nymphs in each treatment (n=210 nymphs). Nymphs were kept individually to eliminate cannibalism. Prey items that were close to the same size as the nymph were offered once per week, with larger prey being offered as the nymphs grew. The percent survival for each treatment was measured by dividing the final number of surviving AWSAB by the initial number in each treatment. Growth rate (GR) was measured by recording the number of days individuals spent in each instar, including the number of days taken to reach maturity. For example, if an individual hatched on May 1 and molted into the 2nd instar on May 25, the number of days spent as a 1st instar nymph would be 24 for that individual. The first day as a 2nd instar would then be recorded as May 25. The number of days taken to reach maturity were compared using an ANOVA (Francke and Jones, 1982). Treatments C and R were analyzed separately from treatments M, CM, CR, RM, and CRM due to a large loss of individuals caused by improper containers.

The overall survival for each treatment was compared against the other treatments by dividing the final number of adults by 35 (the starting number of individuals). Survival was measured using a survival curve in the program JMP. The time for each survival curve was defined by the number of days between hatching and an event occurring, with the event being defined as either the individual reaching maturity or mortality. The individuals that reached maturity were censored out, per the Kaplan-Meyer model (Alfaress et al. 2018).

**Results**

The analysis for each treatment was separated into two groups; Group 1 consisted of treatments C and R while Group 2 consisted of treatments M, CM, CR, RM, and CRM (Table 1). The 7-dram containers used to rear these individuals played a significant role in survival. Many initial losses were caused by non-target effects; the nymphs were kept on damp substrate with no vertical climbing surfaces, forcing them to molt on the substrate itself. This caused mortality due to molting errors, as well as from predation from the intended prey insects. All surviving animals from treatments M, CM, CR, RM, and CRM were moved into larger containers with vertical climbing items. Nearly all bugs in the C and R treatments were lost due to these issues, requiring the treatments to be restarted. The individuals in these two treatments spent the entirety of the experiment in this type of setup, and their data was analyzed separately from Group 2.

There was a significant difference in the number of individuals to reach maturity in Group 1, with no individuals in treatment C reaching maturity and 13 individuals in treatment R reaching maturity. A survival curve can be seen in Figure 6. The total number of individuals that reached maturity can be seen in Table 2.

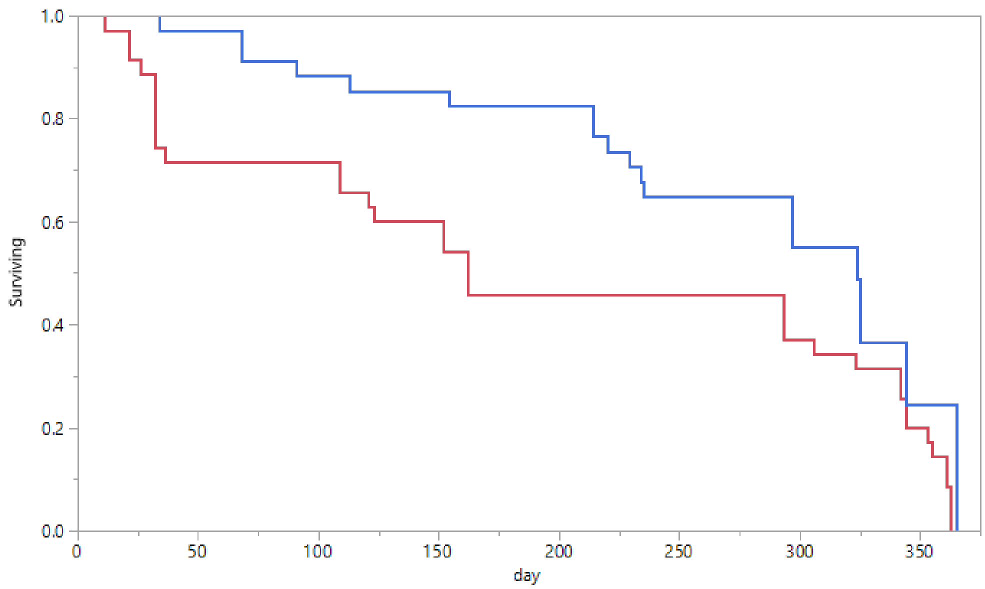


Figure 6. Survival curve for *Platymeris biguttatus* given either crickets (*Acheta domesticus*) or cockroaches (*Blaptica dubia*).. The red line represents survival of individuals given crickets and the blue line represents survival of individuals given cockroaches. Individuals who reached maturity were censored.

Table 2. Total number of individuals surviving to maturity across all treatments. C = received *Acheta domesticus* exclusively, R= received *Blaptica dubia* exclusively, M = received *Tenebrio molitor* exclusively, CR = received alternating portions of *A. domesticus* and *B. dubia* exclusively, CM = received alternating portions of *A. domesticus* and *T. molitor* exclusively, RM = received alternating portions of *B. dubia* and *T. molitor,* CRM = received alternating portions of *A. domesticus*, *B. dubia*, and *T. molitor*. ^Treatments C and R were analyzed separately from M, CR, CM, RM, and CRM.

| Treatment | Total reaching maturity | Percent survival |
|---|---|---|
| **C^** | 0 | 0.0 |
| **R^** | 13 | 0.37 |
| **M** | 4 | 0.11 |
| **CR** | 9 | 0.26 |
| **CM** | 4 | 0.11 |
| **RM** | 3 | 0.09 |
| **CRM** | 3 | 0.09 |

There was a significant difference in the number of days it took to reach maturity in Group 2 (Table 3, Figure 7, $P < 0.05$).

Table 3. The mean number of days taken to reach maturity from egg for *Platymeris biguttatus*. M = received *Tenebrio molitor* exclusively, CR = received alternating portions of *Acheta domesticus* and *Blaptica dubia* exclusively, CM = received alternating portions of *A. domesticus* and *T. molitor* exclusively, RM = received alternating portions of *B. dubia* and *T. molitor*, CRM = received alternating portions of *A. domesticus, B. dubia*, and *T. molitor*.

| Treatment | Mean number of days to maturity |
|---|---|
| RM | 246 |
| CRM | 296 |
| CR | 325 |
| CM | 338 |
| M | 377 |

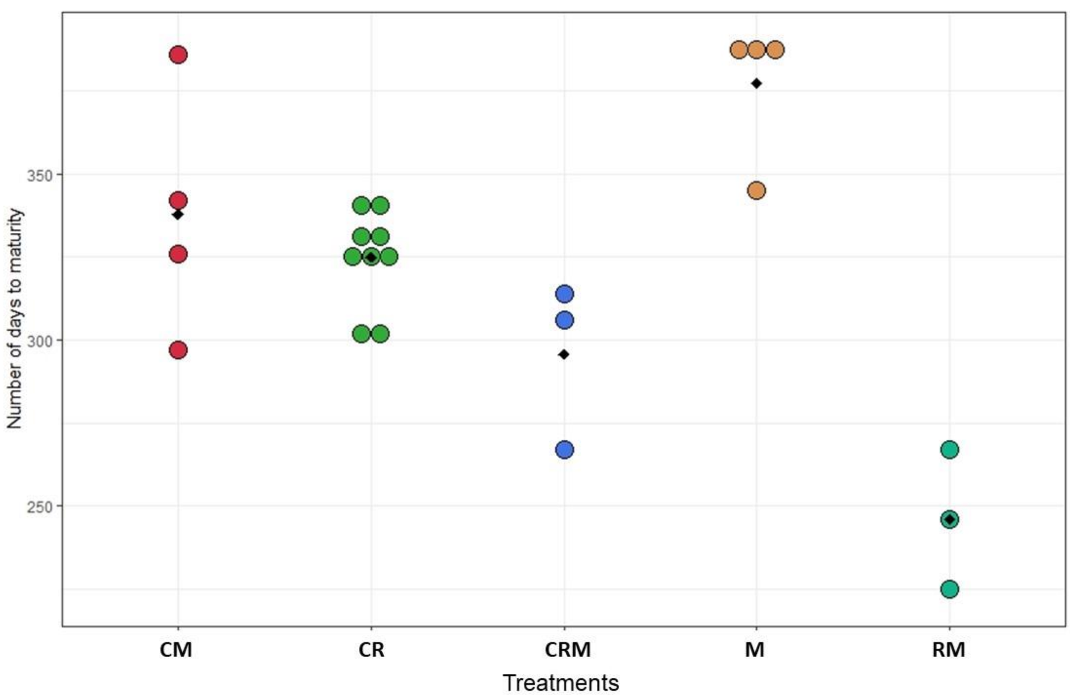


Figure 7. Point plot representing the number of days taken to reach maturity by individuals. M = received *Tenebrio molitor* exclusively, CR = received alternating portions of *Acheta domesticus* and *Blaptica dubia* exclusively, CM = received alternating portions of *A. domesticus* and *T. molitor* exclusively, RM = received alternating portions of *B. dubia* and *T. molitor*, CRM = received alternating portions of *A. domesticus, B. dubia*, and *T. molitor.*

Treatment RM matured the fastest, with the mean number of days to reach maturity being 246 days, followed by the treatment CRM with 296. There was no significant difference in the survival rate between the treatments in Group 2 (Figure 8, $P > 0.05$).

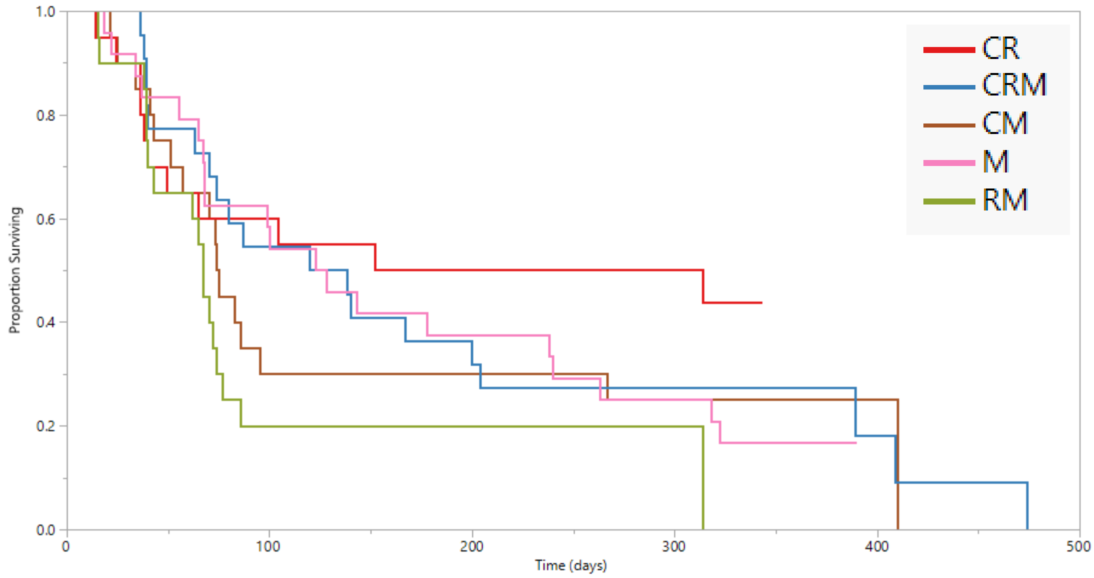


Figure 8 Survival curve of *Platymeris biguttatus* offered different prey species. There was no significance in the survival rate between treatments. M = received *Tenebrio molitor* exclusively, CR = received alternating portions of *Acheta domesticus* and *Blaptica dubia* exclusively, CM = received alternating portions of *A. domesticus* and *T. molitor* exclusively, RM = received alternating portions of *B. dubia* and *T. molitor*, CRM = received alternating portions of *A. domesticus*, *B. dubia*, and *T. molitor*

## Discussion

Based on the results found through offering AWSAB nymphs different prey items, offering Dubia cockroaches as prey should be considered when rearing the AWSAB in captivity. The treatments that received this prey item had the highest survival rate, with 13 individuals surviving to adulthood. However, if the goal of keepers is to have individuals reach maturity quickly, a diet of cockroaches and mealworms, or crickets, cockroaches, and mealworms should be offered throughout the lifespan of the assassin bugs. This experiment offered prey in a 1:1 ratio so the AWSAB had equal amounts of each type of prey they were offered. However, it may be beneficial to offer mealworm larvae less frequently than other prey like crickets and cockroaches. This is because any uneaten larvae will burrow into the substrate to pupate, and any emerging adult beetles will not be eaten by the AWSAB.

Another component of this research that zoos and other groups must consider when determining what to feed their AWSAB colonies is access to common prey items. Because there are no papers written on wild populations of AWSAB, it is hard for husbandry specialists to determine a captive diet that would reflect the diet consumed by wild populations. However, based on the willingness of captive specimens to attack a large variety of prey, it is safe to assume that AWSAB are generalist predators (Eluwa 1967, Edwards 1982, McMonigle 2010, 2015, Sherva 2018).

The species of prey used in this experiment were chosen based on their ease of access. European house crickets and yellow mealworms are two of the most popular insects used by husbandry specialists due to their low cost and easy availability. Dubia cockroaches, however, have become more popular only recently and are not as ubiquitous as the two species mentioned previously. Furthermore, there are substantially higher restrictions on the distribution of cockroaches than crickets and mealworms, making them unavailable to some zoos. Finally, while this species of cockroach can be kept for much longer when compared to crickets, they breed too slowly for many zoos to keep a colony of them as feeders on site and must be regularly purchased.

The price of the prey may also limit a zoo's access to prey species (Table 4).

Table 4 Average price (US$) of the three prey species used. Note that the distribution of Blaptica dubia is limited in the state of Florida and all of Canada without formal permitting

| Prey species | Cost | Ease of access |
|---|---|---|
| **European House Crickets (*Acheta domesticus*)** | $0.15/adult | Extremely easy to purchase from pet stores, bait shops, or available through online retailers. Little to no regulation on distribution. |
| **Yellow Mealworm larva (*Tenebrio molitor* Linnaeus)** | $0.12/larvae | Extremely easy to access from pet stores, animal feed stores, some bait shops, or available through online retailers. Little to no regulation on distribution. |
| **Dubia cockroaches (*Blaptica dubia*)** | $0.37-$1.00/individual depending on size or instar | Relatively easy to purchase from some pet stores or online retailers. Regulated by permits in some areas, including Florida and Canada. |

European house crickets are bred at large facilities and distributed around the country, resulting in a relatively low cost. Yellow mealworm larvae breed well in captivity, with a container of 50 larvae being sold for approximately $6.00 (US). Additionally, yellow mealworms breed readily in containers, and a large stable colony can be quickly established in a 10-gallon (40 liter) tank.

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African white spotted assassin bugs are rarely kept individually in captivity, with a mixed-age colony being the most popular method of rearing. Small nymphs have been seen to feed off the discarded prey left behind by larger AWSAB, and to attack prey in groups of a few nymphs (Li and Cai 2010, McMonigle 2015). It is likely that this species lives communally in the wild as well. However, in this experiment all nymphs were kept individually to limit the risk of cannibalism. This may have had the unintended impact of depriving the animals of their usual hunting habits and forced them to hunt at an earlier age than typically found in a captive or wild population. Indeed, similar studies have shown that the length of development of nymphs is also influenced by being reared individually or communally (Eluwa 1967). This could explain the high mortality in the smaller instars as well as losses due to starvation or predation from intended prey insects.

Furthermore, the containers used to rear these individuals played a significant role in survival. Many initial losses were caused by a flaw in the containers provided to the bugs; the nymphs were kept on damp substrate with no vertical climbing surfaces, forcing them to molt on the substrate itself. This caused mortality due to molting errors, as well as from predation from the intended prey insects. All surviving animals from treatments M, CM, CR, RM, and CRM were moved into larger containers with a plastic plant to allow the bugs to climb off the substrate and molt vertically for the remainder of the experiment. High mortality occurred in the C and R treatments, requiring the treatments to be restarted. The individuals in these two restarted treatments spent their full life cycle the type of setup described above, requiring their data to be analyzed separately from Group 2. Future experiments must consider the need for vertical climbing items and size of container.

This experiment has highlighted the lack of information available to husbandry specialists rearing the AWSAB. While more research is needed to determine the influence diet has on survival and development, this research could be used to imply there are advantages to offering multiple prey species to captive colonies.

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# CHAPTER 2 – CARE FOR THE AFRICAN WHITE SPOTTED ASSASSIN BUG *PLATYMERIS BIGUTTATUS* (HEMIPTERA: REDUVIIDAE)

As mentioned in Chapter 1, little information is available on the best care for *Platymeris biguttatus* (L. 1767) (AWSAB) in captivity. A majority of information on their care is passed by word of mouth from experienced husbandry specialists, with that information often emphasizing their easy care. While it is true that they are a hardier species than others kept in captivity, that does not mean that efforts should not be made to ensure this species receives the best care possible.

The lack of information on how to provide the best care for AWSAB became a problem when rewriting the caresheets for the arthropods kept in the Colorado State University Bug Zoo (CSUBZ). There was little to no information supporting the techniques I was trained to use when providing care to this species, making it difficult to recommend it to others wishing to start their own colony. While there was plenty of anecdotal evidence available on the internet that confirmed how easy they are to keep for display due to their willingness to breed and accept feeder crickets as prey, there was very little published information on the species or their care in captivity. In 2012, Orin McMonigle published a book on the care for exotic arthropods for display, with a section on *P. biguttatus*, that simply provides the information that they can live communally, can eat crickets and cockroaches, and need damp substrate for egg development. McMonigle (2015) published a second book that had more information on the care needed for hemipterans on display. While this book provided new information on general biology and husbandry, much of the specific information on *P. biguttatus* was a repeat of McMonigle (2012). An internet search for *P. biguttatus* care provided a few usable results, with, most coming from websites attempting to sell the insects to hobbyists in the pet trade. A search for scientific studies published on the species resulted in a small collection of papers; between 1960 and 2019, only five studies have been published regarding the AWSAB. The first paper was published in 1967 and describes experiments using nymphs reared in captivity, including the role humidity and temperature plays in hatch rate, the influence of feeding frequency on growth rate in nymphs, and the influence of communal versus solitary rearing on development (Eluwa 1967). Edwards (1982) provided observations on keeping an individual specimen that had been found at the Gatwick Airport in London. Apparently, no additional information was published on the AWSAB between 1982 and 2010. It was not until Li and Cai (2010) described morphological attributes of this species of bug at different nymphal stages in a laboratory setting. It was in this paper that the gender ending of the specific epithet was corrected from *biguttata* to *biguttatus*. A fourth study was published that proposes the potential range of the species based on specimens in museum collections from around the world (Chlond et al., 2015). Finally, a fifth study was published exploring the genetic pathways that produce the stark pigmentation found in this species (Zhang et al., 2019).

At the beginning of my research, I was only able to find the two books published by McMonigle (2012, 2015) and the papers published between 2010 and 2015. However, after I discovered that the specific epithet of the species was corrected from *P. biguttata* to *P. biguttatus* in 2010, I was able to find the two papers published in 1967 and 1982. The most recent paper was then discovered as this chapter was being written (Eluwa 1967, Edwards 1982, Li and Cai 2010, McMonigle 2012, Chlond et al 2015, McMonigle 2015, Zhang 2019).

This lack of care instructions for rearing this species led me to produce my own care sheet as a second chapter. The care sheet I have created is designed to be printed by zoos and other specialists to guide care of this species.

# Care for the African white spotted assassin bug (*Platymeris biguttatus*)

**Other names**: White spotted assassin bug, two spotted assassin bug, African spotted assassin bug

**Scientific name***: Platymeris biguttatus*

**Temperature:** 23-27°C / 70-85°F

**Substrate:** Sand or coconut fiber

**Diet:** Insects

**Difficulty:** Intermediate-Advanced

**Overview**

The African white spotted assassin bug (AWSAB) is often kept in small to medium sized colonies, with adults and juveniles kept together. They are large (2 cm) distinct insects as adults, with vivid white spots and yellow leg bands on a glossy black body (Figure 9).

Figure 9. Adult female African white spotted assassin bug eating a mealworm larva. Photograph: Holmes 2018

While the life cycle of this species is well recorded in captivity, little is known about their natural life cycle. These true bugs are frequently kept as display animals due to their high visibility and willingness to reproduce.

**Temperament**

As is true with almost all assassin bugs, **this species should be handled with extreme care**. Both adults and larger nymphs can deliver an extremely painful bite, along with a venom that can cause rapid painful swelling that lasts for multiple days (George Wittemyer, Colorado State University, 2020, personal communication). Additionally, allergic reactions to this venom have not been studied, and there is a possibility for people to have allergic reactions. Furthermore, when disturbed or stressed, adults and larger nymphs may spray this venom up to one foot (18 cm) in distance, aiming for the perceived threat's eyes. This can cause an extreme burning sensation and temporary blindness, and eyes should be washed in cool water for several minutes (Joseph Sarr, Fort Collins Museum of Discovery, 2016, personal communication). Goggles and gloves are always recommended when cleaning or rearranging their enclosures.

**Diet**

While there is no information available on what the wild diet of this species is, there is much evidence that this species is a generalist predator, willing to hunt a large variety of insects. While crickets remain the easiest and most popular feeder insect used, there is substantial evidence that variety in prey is a better option in captivity. Individuals fed a combination of crickets, cockroaches, and mealworms matured faster than those fed only a single species of prey. Additionally, survival rates are higher in colonies fed only cockroaches compared to those fed only crickets.

The diet of insects is also an important factor when using them as prey. It is recommended to keep prey insects for at least 24 hours after receiving them and offering them constant accesses to food. This technique is referred to as gutloading, and ensures that the prey have nutritional value, and have received the types of nutrients they need to provide your AWSAB a healthy meal. Fresh fruits and vegetables along with specialized feeder diets such as those offered at exotic pet stores should be offered to all prey for at least a day before being fed to AWSAB.

African white-spotted assassin bugs feed by inserting their rostrum (beaks) into their prey and injecting a digestive enzyme. This both kills the prey and causes it to liquify. The bugs then suck the liquified prey through their rostrum (similar to using a straw in a juicebox). Once they have finished feeding on the prey, the bugs will discard the carcass and return to their hiding place. These carcasses are the parts of their prey that were not liquified such as the exoskeletons of insects, and their containers must be cleaned regularly to remove the carcasses.

Assassin bugs are known to attack prey as large if not slighly larger than themselves; when feeding your colony, make sure you are only offering prey that is about the same size as your bugs. For example, a colony of five adult bugs should be offered five medium sized feeder cockroaches or 10 large crickets. It is also possible to occassionally offer a lower number of larger prey, like two adult cockroaches for five adult bugs. This is because adult AWSAB will pair up to take down larger prey. Prey should be offered one to two times a week; make sure all prey has been eaten before offering new prey to avoid over feeding your bugs.

When providing a variety of insects, be sure to only offer animals reared as feeders; wild insects may have come in contact with pesticides and can be extremely dangerous to feed to assassin bugs (or any other animal in captivity). Enough food should be offered so that each adult in the colony is able to feed; adults have been know to pair up to take down prey larger than themselves, so a lower number of larger prey can be offered to colonies with a majority of adults.

**Enclosure**

While AWSAB are an extremely hardy species, they require a few components in their enclosure to thrive. Both horizontal and vertical space are required; open floor space is needed to allow the AWSAB to hunt their prey and deposit their eggs, while vertical areas are required to allow individuals to molt and hide during the day. Items such as hollow logs or cork bark should be placed leaning against the tank to provide a darkened area for the bugs to hide during the day (Figure 10).

Figure 10. A small colony of African white spotted assassin bugs kept on sand. The cork bark in this photo was flipped over to display the adults for the photo but is typically placed to allow adults to hide. Photograph: Holmes 2018.

Vertical surfaces also provide places for the bugs to hang off of as they molt, and a lack of these areas can lead to a high mortality rate. A 10 gallon (40 liter) glass tank with a locking screen lid can support a large colony, provided that there are enough hiding spots for all individuals.

It is extremely important to have a locking lid with small wire meshing on any enclosure used. AWSAB are adept climbers, and young nymphs are capable of climbing the silicone joints used in glass terrariums. Furthermore, the adults have wings and are strong flyers, and will fly out of the enclosure at night given the opportunity.

**Substrate**

A variety of different substrates work for this species, with the most success found using coconut fiber or coir such as EcoEarth. Maintaining humid substrate is an excellent way to ensure that the humidity in the tank stays stable. The substrate should be between 2 and 4 cm and kept humid (but not saturated). Dry sand can also be used if the relative humidity of the air is kept above 40%. This should be offered in conjunction with a container full of damp substrate such as cocofiber for eggs to be deposited in.

**Breeding**

AWSAB are popular display and pet insects due to their willingness and ease of breeding in captivity. It is unknown if females mate once or continually, but a single female can produce hundreds of eggs in her lifetime. Sexing is relatively easy, with males possessing a cup-like cap over their genitalia; identification of this cap at the end of the abdomen can be done by gently flipping adults on their backs using forceps. Additionally, it is possible to determine sex by observing the abdomen from above. Female AWSAB generally have a wider abdomen that extends beyond the margin of the wings while males have abdomens that are the same width of their wings (Figure 11).

A male (left) and female (right) African white spotted assassin bug mating on top of a piece of corkbark. The female can be distinguished by the wider marging of the abdomen extending beyond the wings. Photograph: Holmes 2018.

While this method is not as accurate as checking for a genital cup, it is less disturbing to the bugs and comes with a much lower risk of being sprayed.

After mating, a female AWSAB will begin searching for an area to deposit her eggs. Eggs are individually buried in the substrate, with areas of higher humidity preferred. The female will insert the tip of her abdomen in the substrate and deposit a single egg, and then move to a new area and continue egg deposition. Several hundred eggs can be deposited by a single female during an egg laying period (Eluwa 1967).

There are two methods of rearing AWSAB: free breeding and egg removal. The first method involves simply ensuring the enclosure has consistently damp substrate for eggs to be laid and develop in, with adults and juveniles living together. The latter method involves providing an area for females to deposit their eggs, which are then later removed (see above in **Substrate**).

When using the egg removal method, a container with damp substrate is provided among a dry substrate such as sand. The females will deposit their eggs within the damp substrate, which should be removed weekly. Once removed, the container with eggs is placed in a different enclosure. Care should be taken to ensure that the substrate is consistently damp but not wet. Eggs develop in approximately 21 days at 25°C, at which time small bright red nymphs will emerge (Figure 12).

Figure 12. A first instar nymph of the African white spotted assassin bug. Nymphs are bright red for the first few weeks after hatching and are incredibly small. Photograph: Holmes 2018.

These nymphs should be kept in groups of similar-sized individuals and fed small prey multiple times a week. It is important to keep the humidity and temperature consistent at 50-60% humidity and 25°C (77° F). This can be achieved by using a substrate like coconut fiber to retain moisture. The nymphs will also need places to hide in and climb on, such as cork bark or other tank decorations. The enclosure should follow the same directions above in **Enclosure**, but to a smaller scale; a plastic shoebox sized container can easily fit 25 nymphs for the first three months.

Once the nymphs have grown to be about half the size of adults, they can be reintroduced into the adult container or moved into a larger container (see above in **Enclosure**). It takes about one year for AWSAB to go from egg to adult, with adults living for another six months to a year after reaching maturity. A colony of AWSAB can rapidly expand from several adults if proper care is taken to provide them adequate food, humidity, and enough hiding places.

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