SHORT COURSE:
TROPICAL FIELD BIOLOGY IN COSTA RICA

MAY 21 – JUNE 3 2012

Santa Rosa National Park
La Selva Biological Station
Cerro de la Muerte
Las Cruces Biological Station

Coordinated by:
Ann Russell, Ph.D. and Anjali Kumar, Ph.D.
# Table of Contents:

- Course Coordinators ......................................................................................................... 3
- Resource mentors ............................................................................................................ 3-5
- Students ............................................................................................................................ 6-11
- Drivers ............................................................................................................................... 12
- Course activities ............................................................................................................... 13
- Daily course schedule .................................................................................................... 14-17
- Santa Rosa National Park .............................................................................................. 18
- Volcán Arená and La Fortuna waterfall .......................................................................... 19
- La Selva Biological Station ............................................................................................. 20
- Páramo ............................................................................................................................. 21
- Las Cruces Biological Station ....................................................................................... 22
- En route back to San José ............................................................................................. 23
- Celebrations ..................................................................................................................... 24
- Cultural events .................................................................................................................. 25
- Over the rainbow ............................................................................................................. 26
- Student PowerPoints
  - Tent-roosting bats ........................................................................................................ 27-38
  - Thermal physiology of frogs ...................................................................................... 39-41
  - Litter invertebrates ...................................................................................................... 42-55
  - Caterpillar predation .................................................................................................. 56-71
- Bird List ............................................................................................................................. 72-76
- Santa Rosa Vegetation Comparison Study: Data set ..................................................... 77

NOTE: All photos from Ann Russell, except photo of Anjali Kumar on p. 3.
Course Coordinators

Ann E. Russell, Ph.D.
Ecosystem ecology
Iowa State University
arussell@iastate.edu

Anjali Kumar, Ph.D.
Tropical ecology
Organization for Tropical Studies
kumar.anja@gmail.com

Resource Mentors

Dr. Bernal Rodríguez Herrera
Profesor Escuela de Biología,
Universidad de Costa Rica &
Director Académico, Reserva Biológica Tirimbina
bernalr@tirimbina.org
Steven M. Whitfield, Ph.D.
Post-doctoral Researcher
University of South Dakota
Steven.Whitfield@usd.edu
**Danilo Brenes**  
Lab Manager and Entomologist,  
La Selva Biological Station  
Danilo.brenes@ots.ac.cr

**Flor Cascante**  
Field and research assistant  
La Selva Biological Station

**Rodolfo Quirós**  
Resident Biologist, Naturalist Guide and  
Environmental Education  
Las Cruces Biological Station  
rodolfo.quiros@ots.ac.cr

**Other Resource Personnel (not pictured)**  
**Kenneth Alfaro**, La Selva, Head of Academic Groups and Environmental Development  
kenneth.alfaro@ots.ac.cr

**Alberth Ureña**, La Selva, Academics Groups and Environmental Development Assistant  
alberth.urena@ots.ac.cr

**Marlon Hernández**, La Selva, Field and Research Assistant
Students

Mitch Barazowski
Iowa State University
mitchb@iastate.edu

Xavier Cruz
Iowa State University
xacruz@iastate.edu
Ashley DeLeon
Iowa State University
amariepr@iastate.edu

Ashley Dunlap
Prince Georges Community College
adunlap@students.pgcc.edu
Ricardo Dunmoodie
Morehouse College
ricardo.dunmoodie@gmail.com

Taela Fullilove
Iowa State University
fullilov@iastate.edu
J.C. Rentería  
Iowa State University  
renteria@iastate.edu

Virginia Velez  
University of Texas-Austin  
vvelez89@gmail.com
Tyler Wright
Bennett College
tyler.wright@bennett.edu

Sarah Zahirudin
University of Wisconsin-LaCrosse
zahirudi.sara@uwlax.edu
Drivers:

Edgar Mora and Alvaro Porras
### Course Activities

#### Lectures, Cultural Events, and Professors

<table>
<thead>
<tr>
<th>Topic</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to OTS</td>
<td>Jennifer Stynoski</td>
</tr>
<tr>
<td>Orientation to the Course</td>
<td>Ann Russell</td>
</tr>
<tr>
<td>Orientation to Santa Rosa National Park</td>
<td>Anjali Kumar</td>
</tr>
<tr>
<td>Climate of Costa Rica</td>
<td>Ann Russell</td>
</tr>
<tr>
<td>Classifications of forests &amp; Holdridge Life Zones</td>
<td>Ann Russell</td>
</tr>
<tr>
<td>Leaf Classification</td>
<td>Anjali Kumar</td>
</tr>
<tr>
<td>Introduction to experimental design; Statistical Methods</td>
<td>Anjali Kumar</td>
</tr>
<tr>
<td>The role of research in the ACG’s future</td>
<td>Dan Janzen</td>
</tr>
<tr>
<td>Orientation to La Selva</td>
<td>Kenneth Alfaro</td>
</tr>
<tr>
<td>Introduction to La Selva</td>
<td>Ann Russell</td>
</tr>
<tr>
<td>Welcome to La Selva</td>
<td>Carlos de la Rosa</td>
</tr>
<tr>
<td>Modeling the carbon cycle</td>
<td>Ann Russell</td>
</tr>
<tr>
<td>Tent-roosting bats</td>
<td>Bernal Rodriguez</td>
</tr>
<tr>
<td>Enigmatic faunal declines at La Selva, Costa Rica: Patterns and processes in a collapsing Neotropical herpetofauna</td>
<td>Steven Whitfield</td>
</tr>
<tr>
<td>Intro to Insects</td>
<td>Danilo Brenes</td>
</tr>
<tr>
<td>The benefit of becoming a social butterfly:Communal roosting deters predation</td>
<td>Susan Finkbeiner</td>
</tr>
<tr>
<td>Orientation to Las Cruces</td>
<td>Rodolfo Quiros</td>
</tr>
<tr>
<td>Forest fragmentation</td>
<td>Rodolfo Quiros</td>
</tr>
<tr>
<td>Tropical deforestation and sustainable forestry</td>
<td>Anjali Kumar</td>
</tr>
<tr>
<td>Wrap-up on three goals of course: 1) The scientific method; 2) Drivers of tropical ecology; 3) Opportunities for undergraduates</td>
<td>Ann Russell</td>
</tr>
<tr>
<td>Concert at Teatro Nacional. A Dos Voces Poéticas</td>
<td>Leandro Maia and Dionisio Cabal</td>
</tr>
</tbody>
</table>
OTS Tropical Biology Short Course 2012 – Day by Day

Mon, May 21
All day: Students arrive in Costa Rica
All day: OTS car picks students up at airport, transports them to Hotel Cacts
6:30 pm: Pizza dinner at Hotel Cacts.
8:00 pm Jenny Stynoski, presentation on OTS
8:30 pm: Icebreaker introductions
8:45 pm: Orientation: Ann

Tues, May 22
7:00-7:45 am: Breakfast at Hotel Cacts
8:00 am: Depart for Santa Rosa National Park
    Stop for boots in Bagaces at Ferreteria Unica
12:30 pm: Lunch at Hotel Boyero in Liberia and snack shopping
2:30 pm: Arrive at Santa Rosa, settle in
3:30 pm: Visit La Casona and overlook, Intro to Santa Rosa
5:00-5:30 pm: Free time
5:30-6:00 pm: Dinner
6:30-7:00 pm: Powerpoint: Climate & Holdridge Life Zones
   Evening: Optional Night walk

Wed, May 23  Santa Rosa
6:00-7:00 am: Optional birding.
7:00-7:45 am: Breakfast
8:00-8:30 am: Leaf workshop
8:30-11:00 am: Plant activity and then ‘Intro to forest succession’ during walk in the forest
11:00-11:30 am: Spend time individually to journal: what you’ve observed, develop questions
12:00-1:00 pm: Lunch
1:00-3:00 pm: Free time
3:00-4:15 pm: Share favorite observations, brainstorm, develop questions together, hypotheses to test
4:15-5:00 pm: Field methods
5:30-6:00 pm: Dinner
6:30-7:30 pm: Development of experimental design for next day’s activity
   Evening: Optional Night walk

Thur, May 24  Santa Rosa
6:00-7:00 am: Optional birding.
7:00-7:45 am: Breakfast
8:00-9:00 am: Stats, analytical methods, experimental design
9:00 am –Noon: Field research in two different forests. Note: Driver will drive us to start of Bosque Húmedo and transport us back at 11:50.
12:00-1:00 pm: Lunch
1:00-2:00 pm: Talk by Dan Janzen
2:00-3:00 pm: Free time
3:00-5:00 pm: Analyze, interpret and discuss data
5:30-6:00 pm: Dinner
6:30-7:30 pm: Continue analyzing data and view Posters from Jennifer Power’s group
   Evening: Optional Night walk
Fri, May 25
6:00-7:00 am: Optional birding
7:30 am: Depart Santa Rosa for La Selva.
12:00-2:00: Lunch at La Fortuna Waterfall.
4:00 pm: Arrive at La Selva
4:00-6:00 pm: Sign forms, settle in at River Station
6:00-7:00 pm: Dinner
7:00-8:00 pm: Night walk with La Selva guides

Sat, May 26  La Selva
5:30-6:30 am: Bird-watching (optional)
6:00-7:30 am: Breakfast
7:30-8:30 am: Intro to La Selva powerpoint – Ann
8:30-12:00: Two groups: One goes with Ann to ECOS plots by bike to collect litter for detrital food web project. The other group goes with Anjali for a lecture on predation/trophic interactions. Then the students construct caterpillars and choose their sites.
12:00-1:00 pm: Lunch
1:00-4:30 pm: Detrital food web project: Set up litter samples in Berlese funnels (Lab work) and then discuss the project (classroom). Anjali’s group will put plastilina caterpillars out in the field. Both groups will work on the Intro & Methods to their PowerPoints. Also, videography is an option. If there is time, take walks around La Selva.
4:30-5:30 pm: Individual time journaling: Comparing Santa and La Selva.
5:30-6:00 pm: Free time
6:00-7:00 pm: Dinner
7:00-8:00 pm: Share favorite observations, Mid-course evaluation
8:00-9:00 pm: Optional Night Walk

Sun, May 27  La Selva  Dr. Bernal Rodriguez will work with students on a tent-roosting bat project
5:30-6:30 am: Bird-watching (optional)
6:00-7:30 am: Breakfast
8:00-9:30 am: Charla
9:30-12:00: Collect data
12:00-1:00 pm: Lunch
1:00-5:00 pm: Finish activities with Bernal.
5:00-6:00 pm: Free time
6:00-7:00 pm: Dinner
7:30-8:30 pm: PowerPoint presentation on Tent-roosting bat project

Mon, May 28  La Selva  Dr. Steven Whitfield will work with students on a project on thermal physiology of litter frogs
5:30-6:30 am: Bird-watching (optional)
6:00-7:30 am: Breakfast
8:00-9:00 am: Charla
9:00-noon: Field work
12:00-1:00 pm: Lunch
1:00-5:00 pm: Analyze data
5:00-6:00 pm: Free time
6:00-7:00 pm Dinner
7:00-7:30 pm: PowerPoint presentation on Thermal physiology of frogs and lizards
7:30-9:00 pm: Optional Night Walk

**Tues, May 29  La Selva**

5:30-6:30 am: Bird-watching (optional)
6:00-7:30 am: Breakfast

7:30 am-Noon: Students will divide into two groups, with one group finishing up the activity from Sat, May 26 and the other going on a canopy walk for 2 hrs. The two groups will switch activities in mid-morning. For the detrital food web project (Ann’s group): We will identify to group (and count) the invertebrates trapped in the Berlese funnels and analyze data with 1-way ANOVA. For the predation/trophic interactions project, Anjali’s group will collect the caterpillars and analyze the data using a t-test and ANOVA.

12:00-1:00 pm: Lunch
1:00-5:00 pm: Work up and analyze data and prepare presentations.
5:00-6:00 pm: Free time
6:00-7:00 pm: Dinner
7:30-8:30 pm: Presentation by Susan Finkbeiner on Social butterflies.

**Wed, May 30 - La Selva in the morning**

5:30-6:30 am: Bird-watching (optional)
6:30-7:30 am: Breakfast
8:00-9:00 am: Free time
9:00-10:00 am: PowerPoint presentations on Litter Invertebrate and Predation/Trophic Interaction projects

10:00-11:00 am: Free time for packing, etc.
11:30-Noon: Load the vehicles
12:00-1:00 pm: Lunch
1:00 pm: Depart La Selva for San José
3:00 pm: Arrive Hotel Cacts
3:00-5:30 pm: Free time until dinner. Museums, the Mercado Central, shopping, etc.
5:30-7:30pm: Dinner at Café Mundo. Birthday party.
7:30-10:00 pm: Concert at Teatro Nacional. A Dos Voces Poéticas. Leandro Maia and Dionisio Cabal

**Thur, May 31  Las Cruces**

7:00-7:45 am: Breakfast
8:00 am: Depart Hotel Cacts for Las Cruces
Stop at Cerro de la Muerte and visit páramo.
11:30-12:00 pm: Lunch at La Georgina
4:30 pm: Arrive Las Cruces
5:00 pm: Orientation from Rodolfo Quirós
5:30-6:00 pm: Free time
6:00-7:00 pm: Dinner
7:00-8:00 pm: Charla on Forest Fragmentation: Rodolfo Quirós

**Fri, Jun 1  Las Cruces**

5:30-6:30 am: Bird-watching (optional)
6:30-7:30 am: Breakfast
7:30-Noon: Hike through Secondary, Selectively logged, and Primary Forests with Rodolfo Quirós
12:00-1:00 pm: Lunch
1:00-6:00 pm: Free time
6:00-7:00 pm: Dinner
7:00-8:00 pm: Charla: Tropical Deforestation and Sustainable Forestry: Anjali Kumar

Sat, Jun 2
5:30-6:30 am: Bird-watching (optional)
6:30-7:30 am: Breakfast
8:00-9:00 am: Spend individual time journaling about Las Cruces.
9:00-11:00 am: Discussion and course wrap-up.
11:00-11:30: Pack.
11:30-12:00: Load vehicles
12:00-12:30 pm: Lunch
12:30 pm: Depart Las Cruces
8:00 pm: Farewell dinner at Maria Bonita

Sun, Jun 3
Students depart Costa Rica
Santa Rosa National Park

Presentation by Dan Janzen
Volcán Arenál and La Fortuna Waterfall
La Selva Biological Station
Páramo
Las Cruces Biological Station
En route back to San José
Celebrations
Cultural Events: Concert at Teatro Nacional
Over the Rainbow (Santa Rosa lookout)
Limitations of Social Structure in Tent-Roosting Bats

Xavier Cruz
Ricardo Dunmoodie
Nic Muñoz
JC Renteria
Virginia Velez
Sarah Zahirudin
* Over 1200 bat species
* Relatively short roosting time
* Roost by occupying pre-existing space or create space
* 4 different styles of roosting tents using plants
  * Bifid, inverted boat, apical, and umbrella
Artibeus Watsoni is known to roost using 41 different plants
Most common is Asterogyne Martiana (using Bifid tents)
Relationship between bats and tent is short term
Mating System = 1 male for several females
Average # of bats/tent = 2.1 with max = 4 (Gloriana Chaverri and Thomas H. Kunz 2010)
In tents, slope of main vein cannot equal less than 0°
Question

* Is the social structure of *Artibeus watsoni* limited by the *Asterogyne martiana*’s leaves ability to bear weight?
The social structure of *Artibeus watsoni* is limited by the *Asterogyne martiana*’s leaves ability to bear weight.
A. *watsoni* plants of approximately 1.5 m were identified and one young, erect leaf was selected for testing.

- A stick was used to record the height from the base of the plant to the leaf attachment to the petiole.
- A paper clip was attached 5 cm from the point where the leaf diverges.
Methods Continued...

- Weight was added to the clip at 30 s intervals
- At each interval the change in leaf bend was observed
- After the leaf reached the horizontal plane, the total weight was recorded.
Results

- Average weight = 30.8g ± 12.4g
- Max weight carrying capacity = 63g
- Average bat weight = average weight / average weight of A. watsoni
  - = 30.8g / 11g
  - = 2.8 bats
From literature comes the following:

- Average weight of bats = 11g
- Average bats in A. martiana tent = 2.1 bats
- Max number of bats found in A. martiana = 4 bats
- Max number of A. watsoni found in a group = 8 bats
Discussion (cont.)

- Relevancy
  - Seed Dispersal
Questions?
Student PowerPoints
Thermal Physiology of Frogs

Note: The students’ powerpoint was inadvertently lost from Dropbox and what is presented here is reconstructed by Ann Russell from her notes on the students’ presentation.

Students participating: Mitch Barazowski, Ashley DeLeon, Ashley Dunlap, Taela Fullilove, Fatima Guled, Tyler Wright

Introduction (from Steven Whitfield’s presentation)
- Globally, >30% of amphibian species are threatened with extinction (categories Vulnerable, Endangered, or Critically Endangered by IUCN; Stuart et al. 2004)
- Rapid population declines, extirpations, and extinctions have occurred over the world in the past ~30 years (Stuart et al. 2004)
- Amphibian declines, extirpations, and extinctions are occurring in protected reserves, dubbed “enigmatic declines” (Crump et al. 1992, Stuart et al. 2004, Lips et al., 2006, Whitfield et al. 2007)
- Many mechanisms have been implicated in declines and extirpations: habitat modification, pollution, increased UV-B radiation, emerging infectious diseases, climate change (Collins and Storfer 2003)
- Declines and extinctions occurring at unprecedented rate, homogenizing faunas, presenting unique challenges for “clade-level conservation” (Mendelson et al. 2006, Smith et al. 2009)
- We tested the effect of increasing temperature on the physiology of various species of frogs and lizards.
- The concept was that species differ in the maximum temperature which they can withstand before they begin to suffer physiological effects. This temperature is referred to as the critical thermal maximum (CTmax).

Hypotheses
1) In Rhaebo haematiticus, CTmax increases with body length.
2) Species that are active in the day have a higher CTmax the do nocturnal species.
3) CTmax differs with habitat of the frogs and lizards.

Methods

Frogs and lizards of no particular species were collected in the field along the trail of STR. Once caught with nets or plastic sandwich bags, the bags filled with air and tied so that the specimens could not escape.

In the laboratory, holes were punched around the bottom perimeter of plastic cups and then filled with sand and enough water to reach an inch above the sand. These were then placed into a large plastic bin filled with approximately 2.5cm of water. One specimen was placed into each cup, with a lid and rock used to secure them.

Next hot water was gradually added into the large plastic bin. The temperature of the water was recorded each time hot water was added. The specimens were allowed time to reach the CT max in which they would remain on their backside once flipped with a spoon. When the
specimen remained flipped on its backside for five seconds, the temperature of the water inside its cup was recorded along with the time.

To return the specimen to its original state, its cup is removed from the hot water bath in the large plastic bin, drained of the water inside the cup and placed in a tub of cool water. This process is repeated for the next batch of specimen. They are then removed from the cups, placed in plastic sandwich bags and returned to its habitat.

The method using the thermometer did not work well, so the results reported are for previous experiments conducted by Steven Whitfield.

**Results**

Hypothesis 1. CTmax increased significantly with body length as predicted.

Linear regression results: \( P = 0.0019, R^2 = 0.406, N = 21 \)

Hypothesis 2: Diurnal species of frogs and lizards had a lower CTmax, the opposite of what was expected.
t-test results: $P = 0.0015$, $N = 10$

Hypothesis 3: The CTmax differed with habitat.

![Bar chart showing CTmax values for different habitats](chart)

ANOVA Results: $P = 0.0003$, $N = 44$
Analyzing Leaf–litter Invertebrate Differences Based On Variation In Plant Species

Mitch Barazowski, Xavier Cruz, Ricardo Dunmoodie Nic Munoz, Tyler Wright, and Sarah Zahirudin
Introduction

• An estimated 170,000 species of soil organisms have been identified (Wall and Virginia Press)
• Many of these species are necessary for nutrient cycling
• Mutualistic relationships exist between the soil organisms and the plants (Wall and Virginia Press)
• Plants produce the litter layer that organisms live on and these organisms help decompose the litter into useable nutrients for the plants
Many of the organisms in the soils are arthropods, such as mites, flies, ants, cicadas, wasps, bees, etc.

The group that plays one of the larger roles of decomposition is the mites.

According to Hans Jenny, $E = \int (c_l, o, r, p, t, h)$

In the plots randomly selected and sampled, all other variables were controlled except for organisms ($o$)
Question

- Do differences in an area’s predominant plant species affect a leaf litter’s invertebrates presence?
Methods
Hypothesis 1

- **Hypothesis:**
  - The number of litter invertebrates increases with the mass of the litter

- **Null Hypothesis:**
  - The number of litter invertebrates holds no correlation with the mass of the litter

- **Prediction:**
  - As the mass of the litter sample increases so will the number of invertebrates in the sample

- **Reasoning:**
  - More leaf litter should equate to more habitat and food for the invertebrates
Results: Hypothesis 1

![Graph showing the relationship between litter mass and number of invertebrates, with a linear trend line and a P value of 0.038512.]

P value = 0.038512
Results: Hypothesis 1

![Graph showing the relationship between litter mass and number of invertebrates. The graph includes a trend line and data points. The P value is 0.326956.](image)
Discussion: Hypothesis 1

- Looking at total number of insects versus litter mass, there isn’t a significant relationship.
- Removal of the “rotten log” sample demonstrates very little positive correlation.
- Speculation: could be due to small replicate numbers.
Hypothesis 2

- **Hypothesis:**
  - Number of litter invertebrates differs among plant species
- **Null Hypothesis:**
  - The number of litter invertebrates is not correlated with the plant species
- **Prediction:**
  - There will be a difference in the number of litter invertebrates depending on the plant species
- **Reasoning:**
  - Because the different species produce different types and amounts of litter, there may also be a difference in the amount of invertebrates each litter contains.
Results: Hypothesis 2

P value = 0.018911
Discussion: Hypothesis 2

- Statistical post-hoc analysis doesn’t show significant differences between the plots
  - Exception: border and Hial
  - Can be due to low replicate data (low N)
- Significant differences between the Vogu and border samples, and the Pipa, Hial and Pema samples might appear with more sampling
  - On the border, Vogu can have a greater effect
Implications

- Different species of plants produce different leaf litter composition
- Leaf litter invertebrates are important to nutrient cycling
  - Break down the leaf litter into molecules that can be reused
Questions?
Caterpillar Predation

Ashley DeLeon
Ashley Dunlap
Taela Fullilove
Fatima Guled
JC Renteria
Virginia Velez
Introduction

- Why are the tropics green?
  - If there are so many herbivores present, why are plants so numerous?
  - What is the distribution of herbivores throughout the forest?
  - Predation (+,-)
Introduction

- Predation on caterpillars is mainly done by ants and in the canopy (Loiselle, Farji-Brener. 2002).
  - Canopy habitat is analogous to edge habitat (abiotic)
  - New leaves
  - Nitrogen deficiency in canopy (Kaspari, Yanoviak. 2001.).
- Predation can occur on the leaves because caterpillars are naturally found feeding on leaves.
- Predation can occur on the tree because there is a higher contrast between the color of the tree and the caterpillar.
Hypothesis

- There is a difference in predation between the edge forest and the interior forest.
  - There will be higher predation in the edge forest.
- There is a difference in predation between leaves and trees.
  - There will be a higher predation in the leaves.
  - There will be a higher predation in the trees.
- There is a difference in predation among species.
  - Arthropod predation will be the highest.
Methods
Methods
METHODS

5 Meters

5 Meters

62
Results
Predation in Edge and Interior Forest is Equal

- Percent Predation
- Edge
- Interior

P = 0.619  
DF = 10  
t = 0.513
Birds Are the Only Predator That Show Preference

- **Arthropod**: $P = 0.0833$, $X^2 = 3$
- **Bird**: $P = 0.0046$, $X^2 = 8$
- **Mammal**: $P = 0.7055$, $X^2 = 14$
Predators Show No Substrate Preference

- Percent Predation

- Predators Show No Substrate Preference
  - P = 0.576
  - DF = 22
  - t = 0.567

- Graph showing comparison between Tree and Leaf with percent predation rates.
Specific Predators Also Show No Substrate Preference

- Arthropod: $P = 0.847$, $X^2 = 0.037$
- Bird: $P = 0.479$, $X^2 = 0.5$
- Mammal: $P = 0.705$, $X^2 = 0.143$
The Greatest Predation Came From Arthropods

- Arthropod: 27
- Bird: 7
- Mammal: 7

$P = .0001$  
$X^2 = 18.14$
Discussion

- Similar predation in the edge and interior forest may be due to the likeness of the structure of the habitats (Kol, Menge. 2006.).
- There is higher predation by birds in the edge.....
- Percent predation may not be associated with or limited by the substrate.
- There is a higher number of arthropods than birds or mammals in the forest resulting in the greatest predation (Loiselle, Farji-Brener. 2002).
So Why is the Forest Still Green?

- Caterpillar distribution has no affect on predation levels.

- With 50-61% of all caterpillars being preyed upon, their populations are kept at an equilibrium to prevent excess herbivory.
<table>
<thead>
<tr>
<th>Bird Species</th>
<th>Santa Rosa</th>
<th>La Selva</th>
<th>Las Cruces</th>
<th>Other Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Great Tinamou (Tinamus major)</strong></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thicket Tinamou (Crypturellus soui)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Great Curassow (Crax rubra)</strong></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Crested Guan (Penelope purpurascens)</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Magnificent Frigatebird (Fregata magnificens)</strong></td>
<td></td>
<td></td>
<td>X</td>
<td>(La Caldera beach on the Gulf of Nicoya)</td>
</tr>
<tr>
<td><strong>Bare Throated Tiger Heron (Tigrisoma mexicanum)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cattle Egret (Bubulcus ibis)</strong></td>
<td></td>
<td></td>
<td></td>
<td>(Along the road)</td>
</tr>
<tr>
<td><strong>Great Blue Heron (Ardea herodias)</strong></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Snowy Egret (Egretta thula)</strong></td>
<td></td>
<td></td>
<td></td>
<td>(Along road)</td>
</tr>
<tr>
<td><strong>Black Vulture (Coragyps atratus)</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Turkey Vulture (Cathartes aura)</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Swallow Tailed Kite (Elanoides forficatus)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Roadside Hawk (Buteo magnirostris)</strong></td>
<td>X</td>
<td></td>
<td>X</td>
<td>(Roadsides)</td>
</tr>
<tr>
<td><strong>Crested Caracara (Caracara cheriway)</strong></td>
<td>X</td>
<td></td>
<td>X</td>
<td>(Roadside)</td>
</tr>
<tr>
<td><strong>Yellow-headed Caracara (Milvago chimachima)</strong></td>
<td></td>
<td></td>
<td></td>
<td>(Roadside)</td>
</tr>
<tr>
<td><strong>Laughing Falcon (Herpetotheres cachinnas)</strong></td>
<td></td>
<td></td>
<td></td>
<td>(Heard)</td>
</tr>
<tr>
<td><strong>Gray-necked Wood Rail (Aramides cajanea)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Red-billed Pigeon (Patagioenas flavirostris)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Short-billed Pigeon (Patagioenas nigrostris)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>White-winged Dove (Zenaida asiatica)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gray-headed Dove (Leptotila plumbeiceps)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Orange-fronted Parakeet (Aratinga canicularis)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Orange-chinned Parakeet (Brotogeris jugularis)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Great Green Macaw (Ara ambiguus)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mealy Parrot (Amazona farinosa)</strong></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yellow-naped Parrot (Amazona auropalliata)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Squirrel Cuckoo (Piaya cayana)</strong></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Smooth-billed Ani (Crotophaga ani)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groove-billed Ani</td>
<td><em>Crotophaga sulcirostris</em></td>
<td>X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific Screech-Owl</td>
<td><em>Mergus cooperi</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Pauraque</td>
<td><em>Nyctidromus albicollis</em></td>
<td>X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-collared Swift</td>
<td><em>(Streptoprocne zonaris)</em></td>
<td>X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stripe-throated Hermit</td>
<td><em>(Phaethornis srtigularis)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-billed Hermit</td>
<td><em>(Phaethornis longirostris)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiery-throated Hummingbird</td>
<td><em>(Panterpe insignis)</em></td>
<td>X (Lunch after Cerro de la Muerte)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnificent Hummingbird</td>
<td><em>(Eugenes fulgens)</em></td>
<td>X (Lunch after Cerro de la Muerte)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-necked Jacobin</td>
<td><em>(Florisuga mellivora)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rufous-tailed Hummingbird</td>
<td><em>(Amazalia tzacat)</em></td>
<td>X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Violet-ear</td>
<td><em>(Colibri thalassinus)</em></td>
<td>X (Lunch after Cerro de la Muerte)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple-throated Mountain Gem</td>
<td><em>(Lampornis calolaemus)</em></td>
<td>X (Lunch after Cerro de la Muerte)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-headed Trogon</td>
<td><em>(Trogon melanocephalus)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-throated Trogon</td>
<td><em>(Trogon rufus)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elegant Trogon</td>
<td><em>(Trogon elegans)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slaty-tailed Trogon</td>
<td><em>(Trogon massena)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue-crowned Motmot</td>
<td><em>(Momotus momota)</em></td>
<td>X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rufous Motmot</td>
<td><em>(Baryphthengus martii)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broad-billed Motmot</td>
<td><em>(Electron platyrhynchum)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turquoise-browed Motmot</td>
<td><em>(Eumomota superciliosa)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ringed Kingfisher</td>
<td><em>(Ceryle torquatus)</em></td>
<td>X (Roadside)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-necked Puffbird</td>
<td><em>(Notharchus macrorhynchos)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rufous-tailed Jacamar</td>
<td><em>(Galbula ruficauda)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chestnut-mandibled Toucan</td>
<td><em>(Ramphastos swainsonii)</em></td>
<td>X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keel-billed Toucan</td>
<td><em>(Ramphastos sulfuratus)</em></td>
<td>X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collared Aracari</td>
<td><em>(Pteroglossus torquatus)</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>Symbol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiery-billed Aracari</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pteroglossus frantzii</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-cheeked Woodpecker</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Melanerpes pucherani</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoffman's Woodpecker</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Melanerpes hoffmannii</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chestnut-colored Woodpecker</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Celeus castaneus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pale-billed Woodpecker</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Campephilus guatemalensis</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lineated Woodpecked</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dryocopus lineatus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern Barred-Woodcreeper</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dendrocolaptes sanctithomae</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wedge-billed Woodcreeper</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Glyphorhynchus spirurus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olivaceous Woodcreeper</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Sittasomus griseicapillus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streak-headed Woodcreeper</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Lepidocolaptes souleyetti</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasciated Antshrike</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cymbilaimus lineatus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Tody-Flycatcher</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Todirostrum cinereum</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bright-rumped Attila</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Attila spadiceus</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Royal Flycatcher</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Onychorhynchus coronatus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown-crested Flycatcher</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Myiarchus tyrannulus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dusky-capped Flycatcher</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Myiarchus tuberculifer</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Kiskadee <em>(Pitangus sulphuratus)</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streaked Flycatcher</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Myiodynastes maculatus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphur–bellied Flycatcher</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Myiodynastes luteiventris</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical Kingbird <em>(Tyrannus melancholicus)</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cinnamon Becard</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pachyramphus cinnamomeus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masked Tityra <em>(Tityra semifasciata)</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-collared Manakin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Manacus candei</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-tailed Manakin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Chiroxiphia linearis</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow-green Vireo <em>(Vireo flavoviridis)</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-throated Magpie Jay</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Calocitta formosa</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-lobed Gnatchatcher</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Polioptila albitoris</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rufous-naped Wren</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Cerro de la Muerte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>--------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band-backed Wren</td>
<td><em>Campylorhynchus rufinucha</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stripe-breasted Wren</td>
<td><em>Thryothorus thoracicus</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rufous and white Wren</td>
<td><em>Thryothorus rufalbus</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plain Wren</td>
<td><em>Thryothorus modestus</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banded Wren</td>
<td><em>Thryothorus pleurostictus</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sooty Robin</td>
<td><em>Turdus nigrescens</em></td>
<td>X (Cerro de la Muerte)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Throated Robin</td>
<td><em>Turdus assimilis</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay-colored Robin</td>
<td><em>Turdus grayi</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golden-winged Warbler</td>
<td><em>Vermivora chrysoptera</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilson’s Warbler</td>
<td><em>Wilsonia pusilla</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buff-rumped Warbler</td>
<td><em>Phaeothlypis fulvicauda</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rufous-capped Warbler</td>
<td><em>Basileuterus rufifrons</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bananquit</td>
<td><em>Coereba flaveola</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Bush-Tanager</td>
<td><em>Chlorospingus ophthalmicus</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gray-headed Tanager</td>
<td><em>Eucometis penicillata</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passerini’s Tanager</td>
<td><em>Ramphocelus passerinii</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherrie’s Tanager</td>
<td><em>Ramphocelus costaricensis</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crimson-collared Tanager</td>
<td><em>Ramphocelus sanguinolentus</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golden-hooded Tanager</td>
<td><em>Tangara larvata</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver-throated Tanager</td>
<td><em>Tangara icterocephala</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue-gray Tanager</td>
<td><em>Thraupis episcopus</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm Tanager</td>
<td><em>Thraupis palmarum</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scarlet-thighed Dacnis</td>
<td><em>Dacnis venusta</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Honeycreeper</td>
<td><em>Chlorophanes spiza</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable Seedeater</td>
<td><em>Sporophila americana</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olive Sparrow</td>
<td><em>Arremonops rufivirgatus</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stripe-headed Sparrow</td>
<td><em>Aimophila ruficauda</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volcano Junco</td>
<td><em>Junco vulcani</em></td>
<td>X (Cerro de la Muerte)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bird Name</td>
<td>Scientific Name</td>
<td>Beach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buff-throated Saltator (_{Saltator maximus})</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-faced Grosbeak (_{Caryothraustes poliogaster})</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great-tailed Grackle (_{Quiscalus mexicanus})</td>
<td>X X X X (Beach)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-cowled Oriole (_{Icterus prosthemelas})</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spot-breasted Oriole (_{Icterus pectoralis})</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chestnut-headed Oropendola (_{Psarocolius wagleri})</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Montezuma Oropendola (_{Psarocolius montezuma})</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Santa Rosa National Park: Class activity comparing variables in two different vegetation types**

Class data taken on transects (10 x 2m) in Bosque Humedo (mature) and secondary forest

Date of data collection: 24 May 2012

Note: Variables were selected and measured by students.

<table>
<thead>
<tr>
<th>Site</th>
<th>Rep</th>
<th>Litter depth</th>
<th>Leaf Area</th>
<th>Simple Leaves in Understory</th>
<th>Tree Density</th>
<th>% Light Entering at ~ 2 m above forest floor</th>
<th>Number of Seedlings</th>
<th>Tree Diameter (&gt;10cm)</th>
<th>Number of Large Aboveground Roots</th>
<th>Avg. Root Diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature</td>
<td>1</td>
<td>4.00</td>
<td>30.85</td>
<td>100</td>
<td>38</td>
<td>14</td>
<td>8.1</td>
<td>44.6</td>
<td>2</td>
<td>3.0</td>
</tr>
<tr>
<td>Mature</td>
<td>2</td>
<td>4.71</td>
<td>20.11</td>
<td>87</td>
<td>16</td>
<td>19</td>
<td>6.2</td>
<td>19.2</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td>Secondary</td>
<td>1</td>
<td>2.15</td>
<td>22.47</td>
<td>100</td>
<td>48</td>
<td>61</td>
<td>8.4</td>
<td>0.0</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Secondary</td>
<td>2</td>
<td>2.98</td>
<td>14.04</td>
<td>75</td>
<td>54</td>
<td>41</td>
<td>11.3</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>