A GLOBAL TRAGEDY: CORAL BLEACHING NOW WIDESPREAD IN AUSTRALIA'S GREAT BARRIER REEF

Coral bleaching near Heron Island, Australia in February 2016. This area was one of the first to bleach at Heron Island which is located close to the southernmost point of the Great Barrier Reef.

XL Catlin Seaview Survey

Week 3

(Preparing for) **Tuesday's lecture:**

Budgeting homework time (70 min): In Ch. 17, section 17.1 is 262 words, and section 17.2 (the first half on **fireflies**), is 2569 words in length, together totaling almost 2900 words. This should take 15-20 minutes if you just read it. But when done properly, when you pause to watch the three short movies, and then review a few data figures, read and think about a few of the Integrating Questions, and take careful notes, this assignment should take you 70 minutes (if you are focused).

1. _______ **For Tuesday's lecture first read Chapter 17's,** very short, section 17.1.

2. _______Then slowly carefully read the first half of section 17.2 "How is information transmitted between members of animal species?" For section 17.2 you only need to carefully take handwritten notes in the section "Simple communication in a firefly". Be sure to watch the three short movies about the research of Dr. Sara Lewis.

3. _______ **Try to answer some Integrating Question**. As you read the ICB textbook always attempt to test yourself a little, answer at least one of each set.

4. _______ (Trifecta): **Prepare to explain (aloud) Figures 17.3, 17.4, and 17.5 in class**.

17.1 + 17.2 Behavior + Info exchange

- New Chapter Intro Cover Page + Grid
  Photo Konrad Lorenz known for discover
  (this chapter continues but smaller organism

Interpret playback experiments + LGs relev

17.1 What is information at the population

Fig 17.1 Cartoon birds talk + eavesdropp
"Non-heritable" information, imperfect in

17.2 How is information transfer between m

LGs (LOs) –

Lorenz quote, he studied social goo
Many animals understand language of
prior experience. The ability to communi
Yet the act of communicating → transfer

Fig 17.2 photo of four animal groups – behav

IQ 2. functions of animal comm in Fig 17.2
* Selective advantage → of various behavi

Firefly Photinus (genus) Beetles / inse
risk – attract predators with flashing li
Q: What is chemistry involved?

In eastern US, male fireflies actively signal
after sunset (during summer). Fly / meter

Dr. Sara Lewis + team (Exp #1) 2006 Tufts U

/ Fig 17.3

Purpose – determine variation in signalling between males

Methods
- prerecorded 221 interpulse intervals (I
- digital camcorder
- analyze video to measure IPIs.

Findings:
- Temperature slows – lengthens IPI due temp → chemistry of biolumin..
- But if normalize (standardize) if all were 21.1°C → can view all on and see variation occurs → imperfect tr

(Exp #2)

[Fig 17.4]

Purpose – determine how females respond to va IPIs + at varying temperatures.

Method –
Playback light signalling used by male
Simulate / recreate IPIs of males. w/ LED
Performed at three air temperature
Analysis combined data collected at 18.8
5 intervals tested at each temp.
IPIs 1.2, 1.4, 1.6, 1.8 + 2.0 seconds. (mean
Female response is single flash.

Findings – cooler temps → slower – longer IPIs to attract ↑ % females
– peak point surrounded by decrease – fir

As the summer lasts predators reduce # males so broader IPI attracts females more than before.

Flashing light more difficult to find than constant particularly in moving in 3-D space.
(we have experienced this when capturing fire

(Exp #3) J. Lloyd and Team 1969
Univ. of Florida

Fig 17.5

Purpose – Does IPI vary from species to species and do females notice as a result?

Methods – LED pulses used to simulate double IPIs used by three species of flies (n=1 to 3).
Record # females responding of P. gre spe

Findings – P. greeni females did not respond to IPIs of related species
1 IPIs permit recognition of member species
2 males + females to locate each o receptive through dialogue to

(Evolution) likely explains Fig 17.5

Integrating Concepts in Biology

Chapter 17:
Behavior and Information Exchange

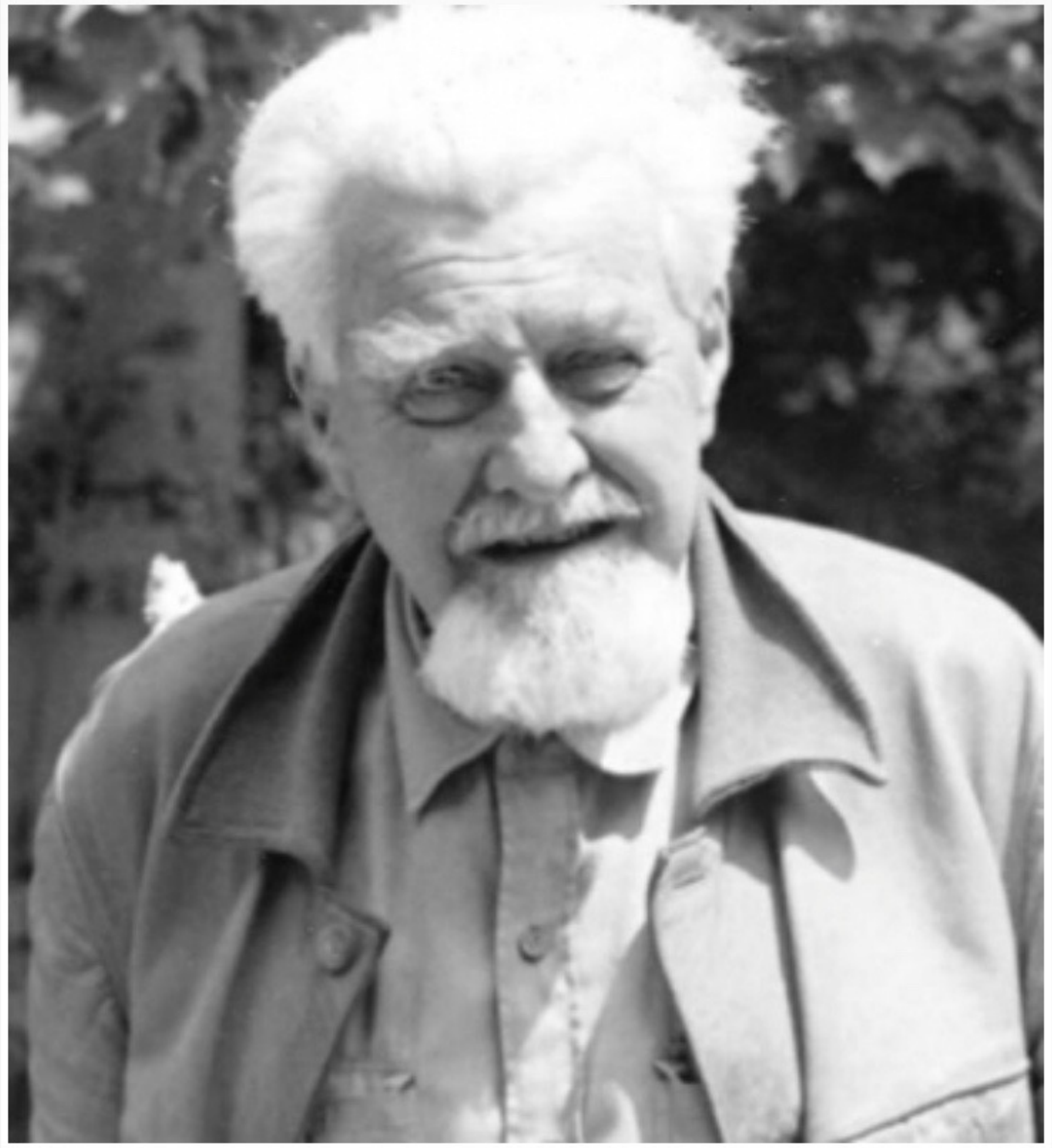
Section 17.1: What is information at the population level?
Section 17.2: How is information transmitted between members of animal species?

by A. Malcolm Campbell, Laurie J. Heyer, & Christopher Paradise

Chapter 17: Behavior and Information Exchange

Overview | Course Glossary | Pending Content | Forums

Have you ever found it difficult to get your point across, or wondered why no one told you about the important assignment you missed when you were absent from class? Communication between individuals is a challenging part of everyday life for humans, and miscommunication often leads to conflict and even wars. But without communication, you would have no friends, and you would eventually find it hard just to survive. Many animals exchange information with each other in response to their environment. You have probably heard animals make noises or seen them display behaviors to communicate with other members of their species or with other species. However, you may not realize that plants and even single-celled organisms send signals to each other using simpler forms of communication, which are hardwired into their DNA. As with humans, miscommunication can lead to trouble for individuals, but it also leads to variation, which is a key component of evolution. In this chapter, you will study the Big Idea of Information at the population level in the form of communication in animals and plants. Through careful observation and controlled experiments, you can interpret the signals and understand these organisms better. You might even uncover a lesson for human communication.



Animal behaviorist Konrad Lorenz discovers the principle of imprinting, which is where an animal identifies another animal as a parent. Author: Eurobas. Creative Commons Attribution-Share Alike 3.0 from Eurobas

you are here		Big Ideas of biology				
		Information	Evolution	Cells	Homeostasis	Emergent Properties
levels of the biological hierarchy	molecules	1	4	7	10	13
	cells	2	5	8	11	14
	organisms I	3	6	9	12	15
	organisms II	16	19	22	28	25
	populations	17	20	23	29	26
	ecological systems	18	21	24	30	27

Section 17.2: How is information transmitted between members of animal species?

Biology Learning Objectives

Carbonless paper notebook exercise

- Describe the function/purpose of communication and information transfer between organisms.
- Explain how animals communicate and find each other through the use of different signals.
- Evaluate costs and benefits of signaling using light and/or sound.
- Interpret playback experiments used to decode signals sent between members of the same species.

Are we studying Ecology or Evolution?

A population of birds and information transfer between individuals

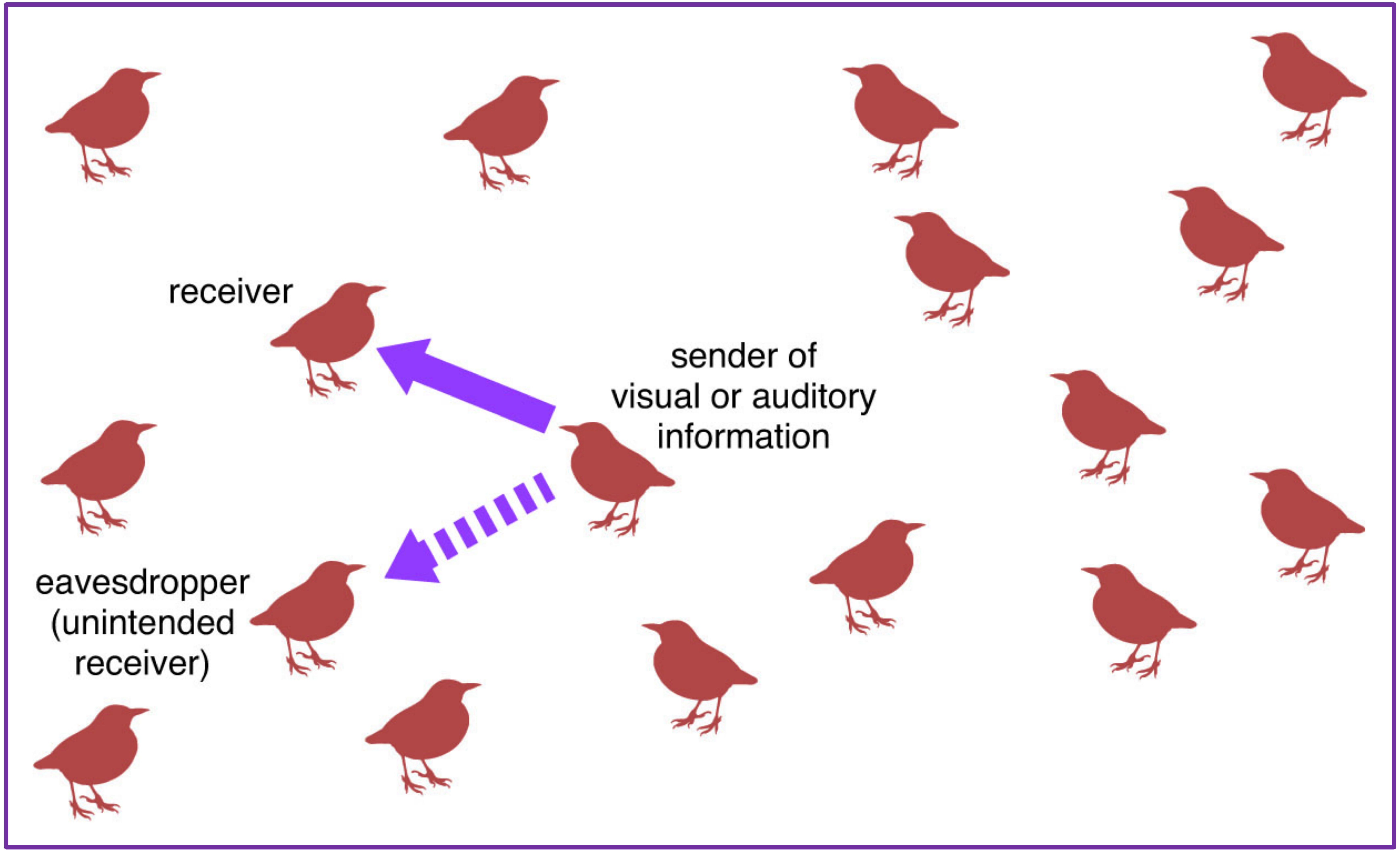


Figure 17.1

A population of birds and information transfer between individuals

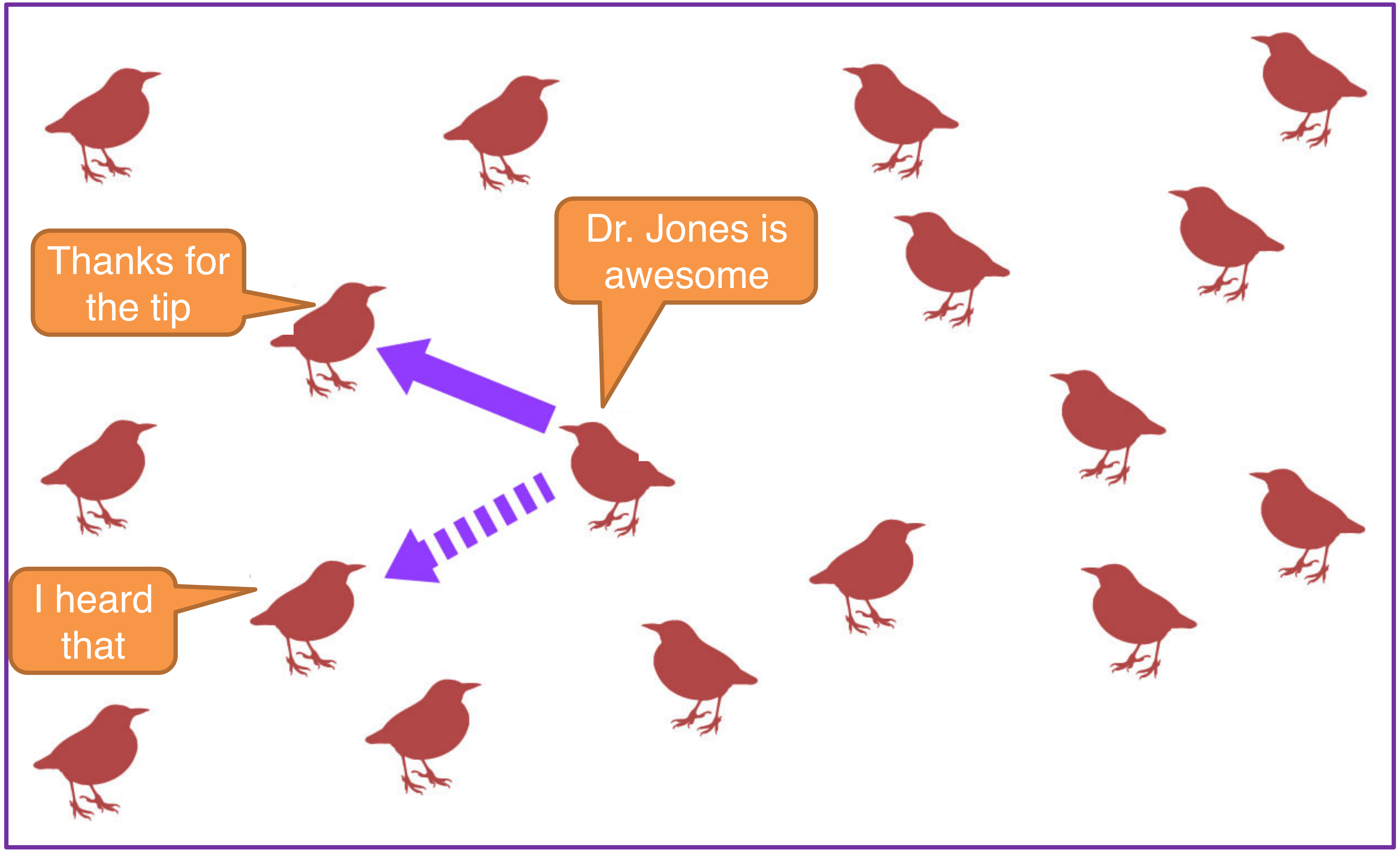
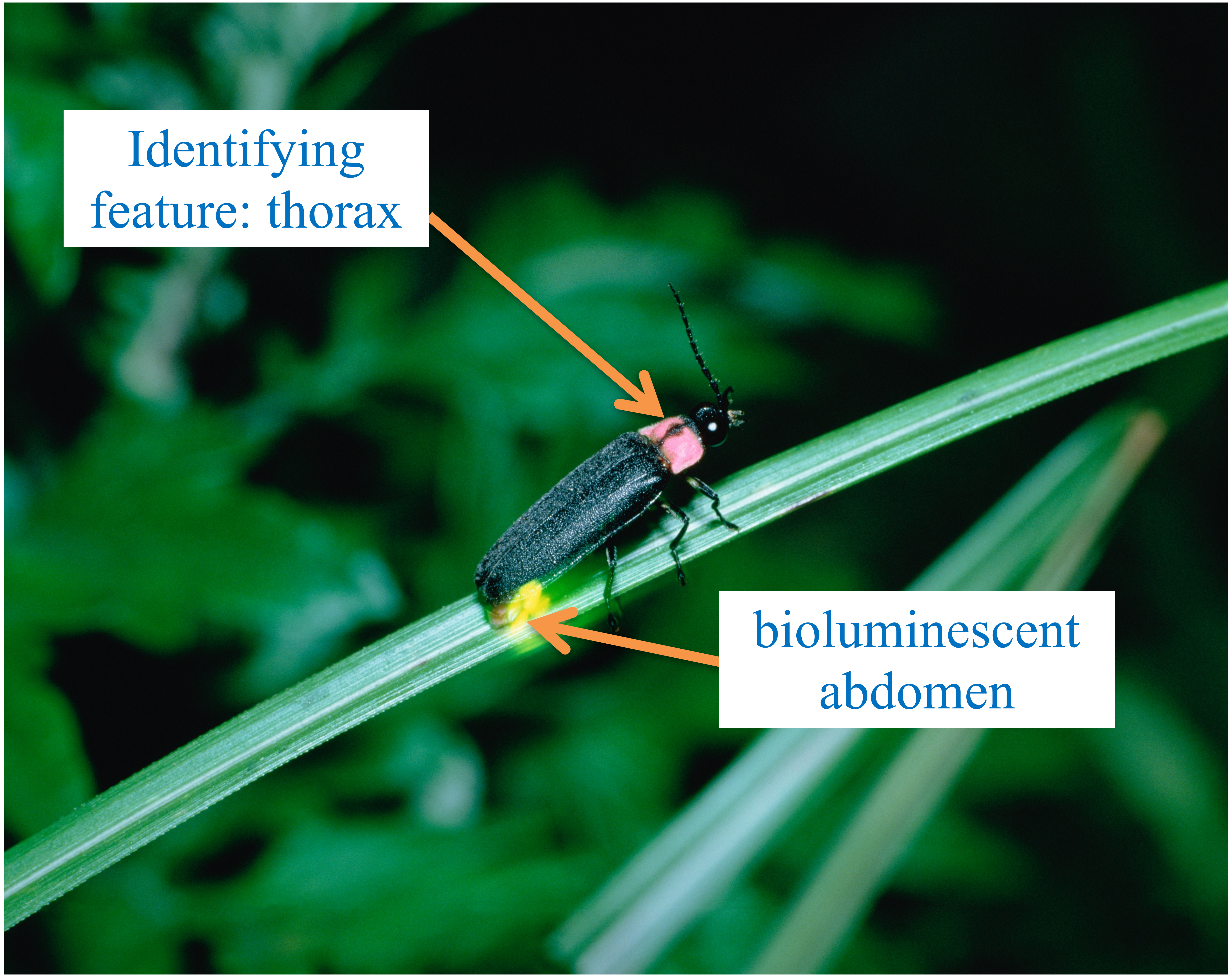


Figure 17.1

A firefly of the *Photinus* genus



Trifecta?

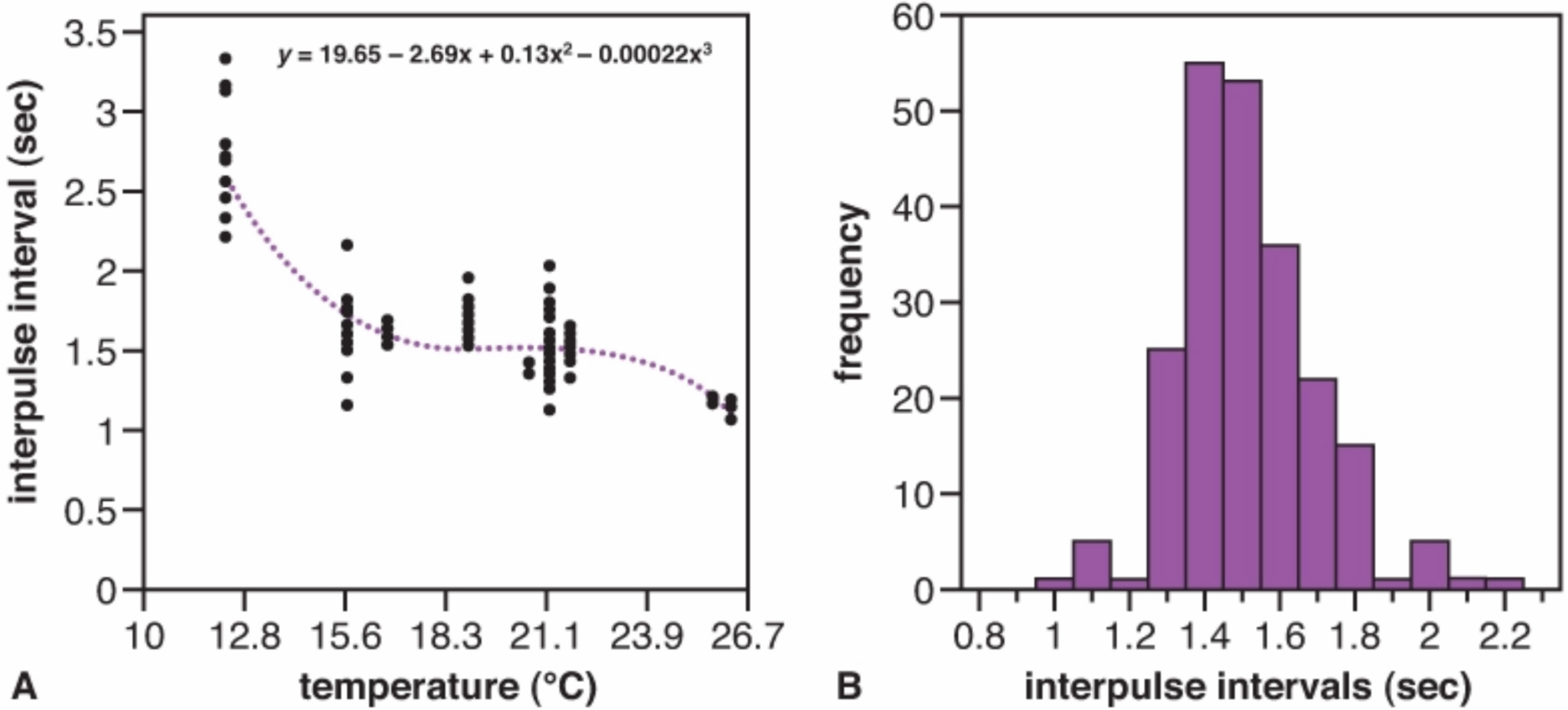
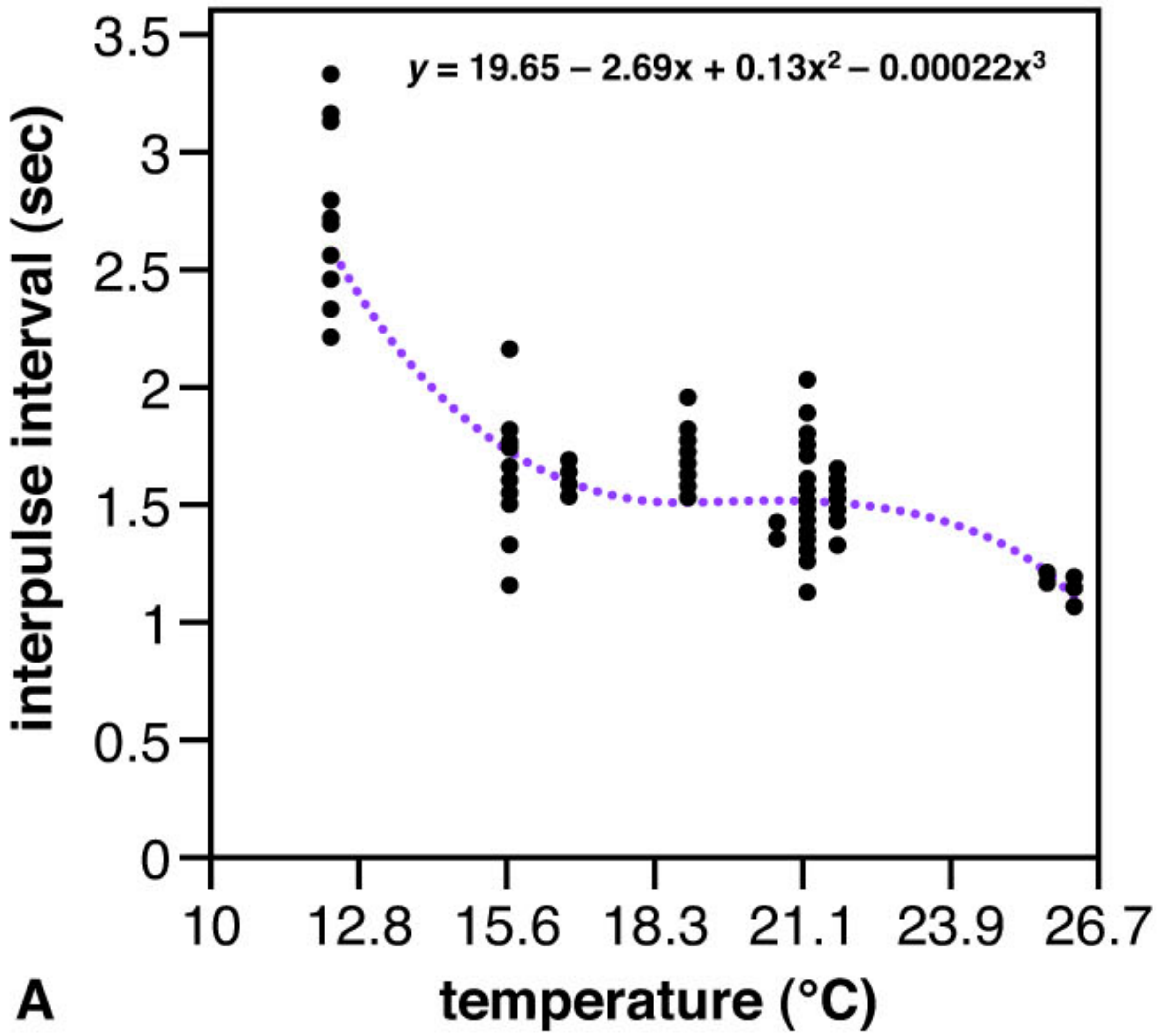


Figure 17.3 Variation in firefly IPIs. **A,** Intervals of time between pulses of light in the courtship signal of male *P. greeni*, measured at different ambient air temperatures in June. A polynomial regression equation (shown at the top of the graph) was fitted to the data. **B,** Frequency distribution of time intervals between pulses for male *P. greeni* adjusted to 21.1° C. Modified from Michaelidis et al., 2006, Figures 1 and 2, reprinted by permission of Oxford University Press.



y = 19.65 – 2.69x + 0.13x² – 0.00022x³
3.5
3
2.5
2
1.5
1
0.5
0
interpulse interval (sec)
10
12.8
15.6
18.3
21.1
23.9
26.7
temperature (°C)
A

Figure 17.3

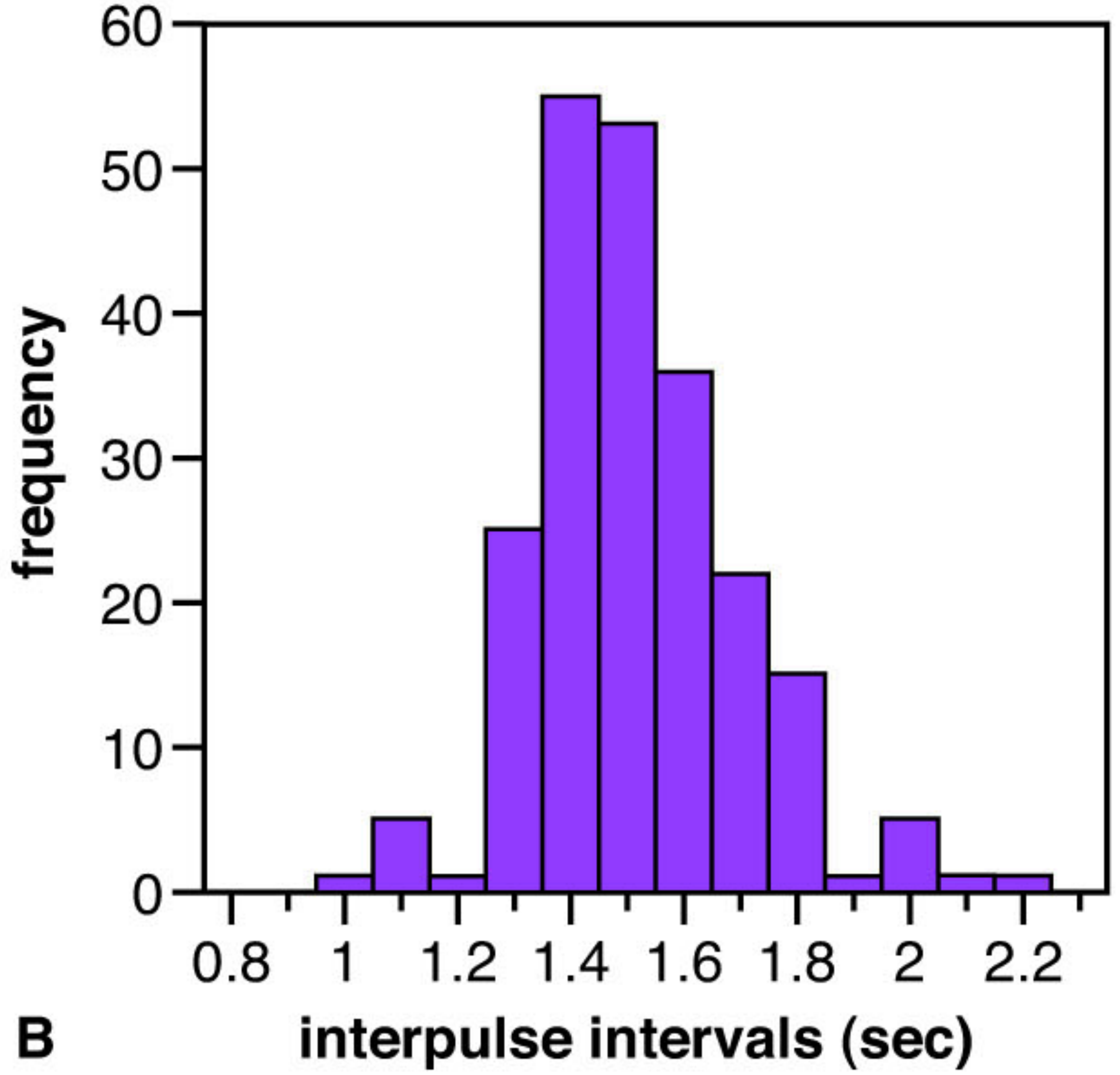
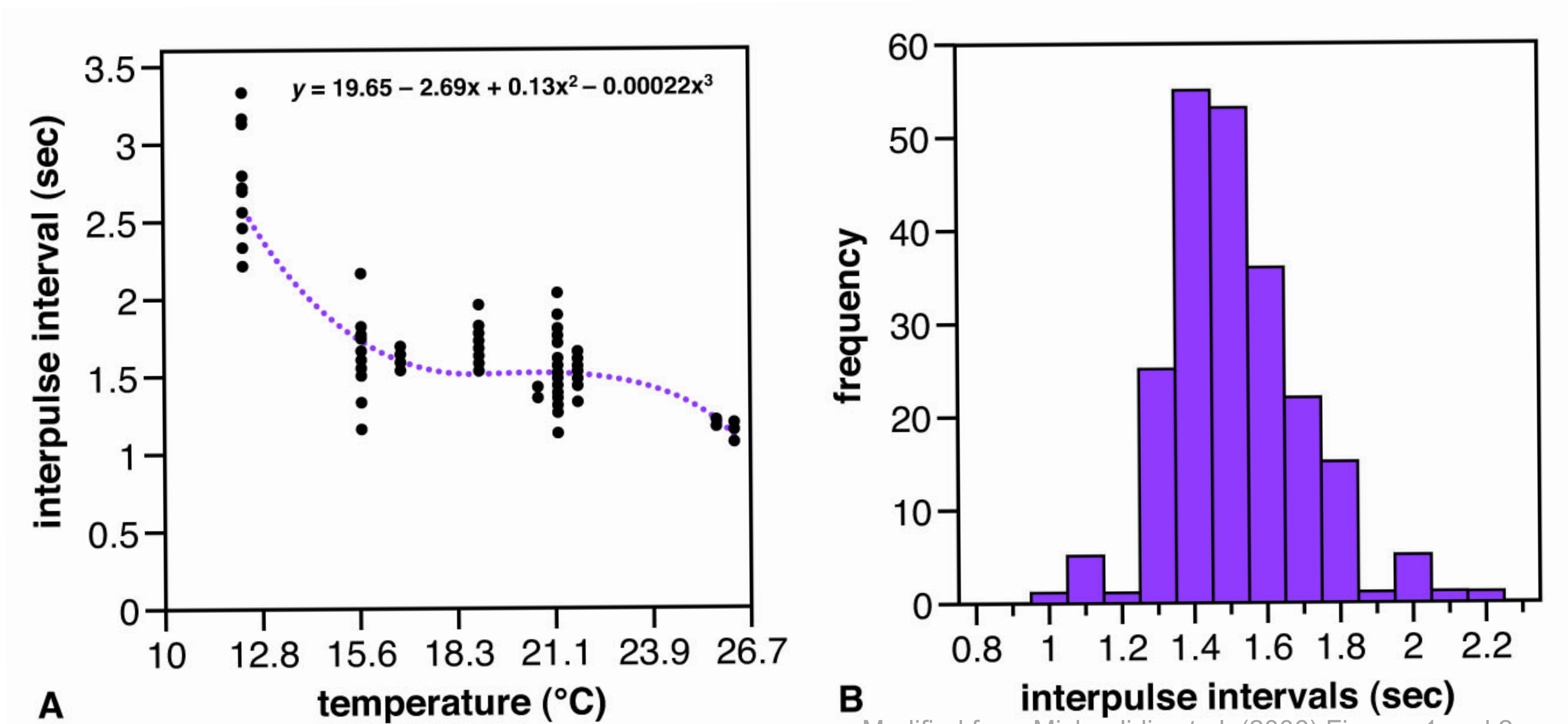

60
50
40
30
20
10
0
frequency
0.8
1
1.2
1.4
1.6
1.8
2
2.2
B
interpulse intervals (sec)

Figure 17.3B

4. Describe the relationship between flash interval and temperature in Figure 17.3A. What is the response of flash intervals and the significance of this response to temperatures between 15.6º C and 21.1º C? What about temperatures below 15º C or above 21º C?

5. Lewis and her colleagues standardized their data by converting IPIs to values that would occur at a standard temperature, as shown in Figure 17.3B. Why did they do that?



Modified from Michaelidis et al. (2006) Figures 1 and 2.
Reprinted by permission of Oxford University Press.

Figure 17.3

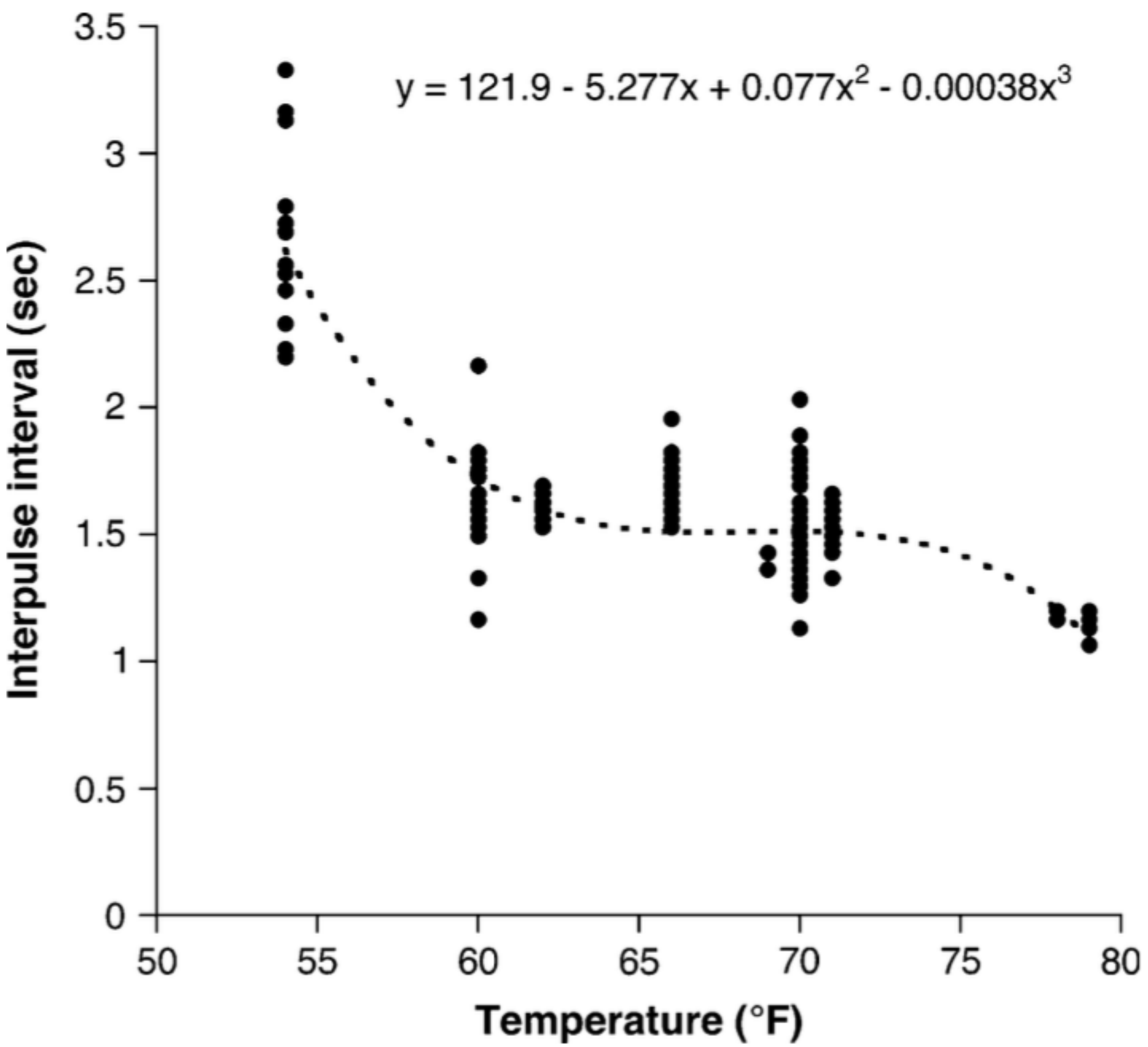


Figure 1
Dependence of field-recorded male *Photinus greeni* courtship IPI on ambient air temperature ($r^2 = .724$). Male IPIs were video recorded in the field ($n = 221$ flash patterns), and a polynomial regression was used to temperature adjust all male IPIs to 70°F (see Figure 2).

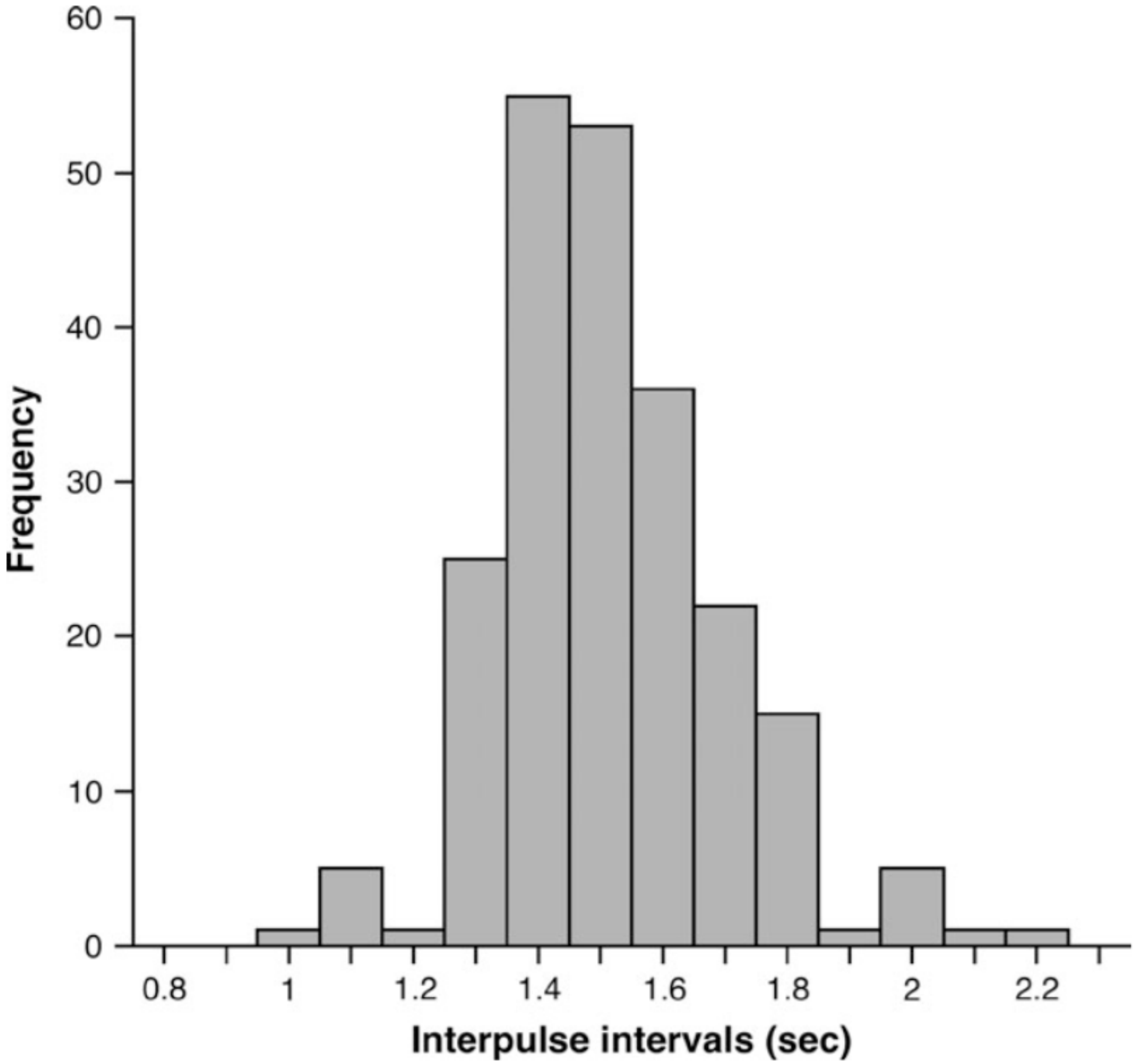


Figure 2
Frequency distribution of male IPIs (temperature adjusted as described in methods) from field-recorded *Photinus greeni* males ($n = 221$ two-pulsed flash phrases recorded from 30 males).

What about this experiment?

Trifecta?

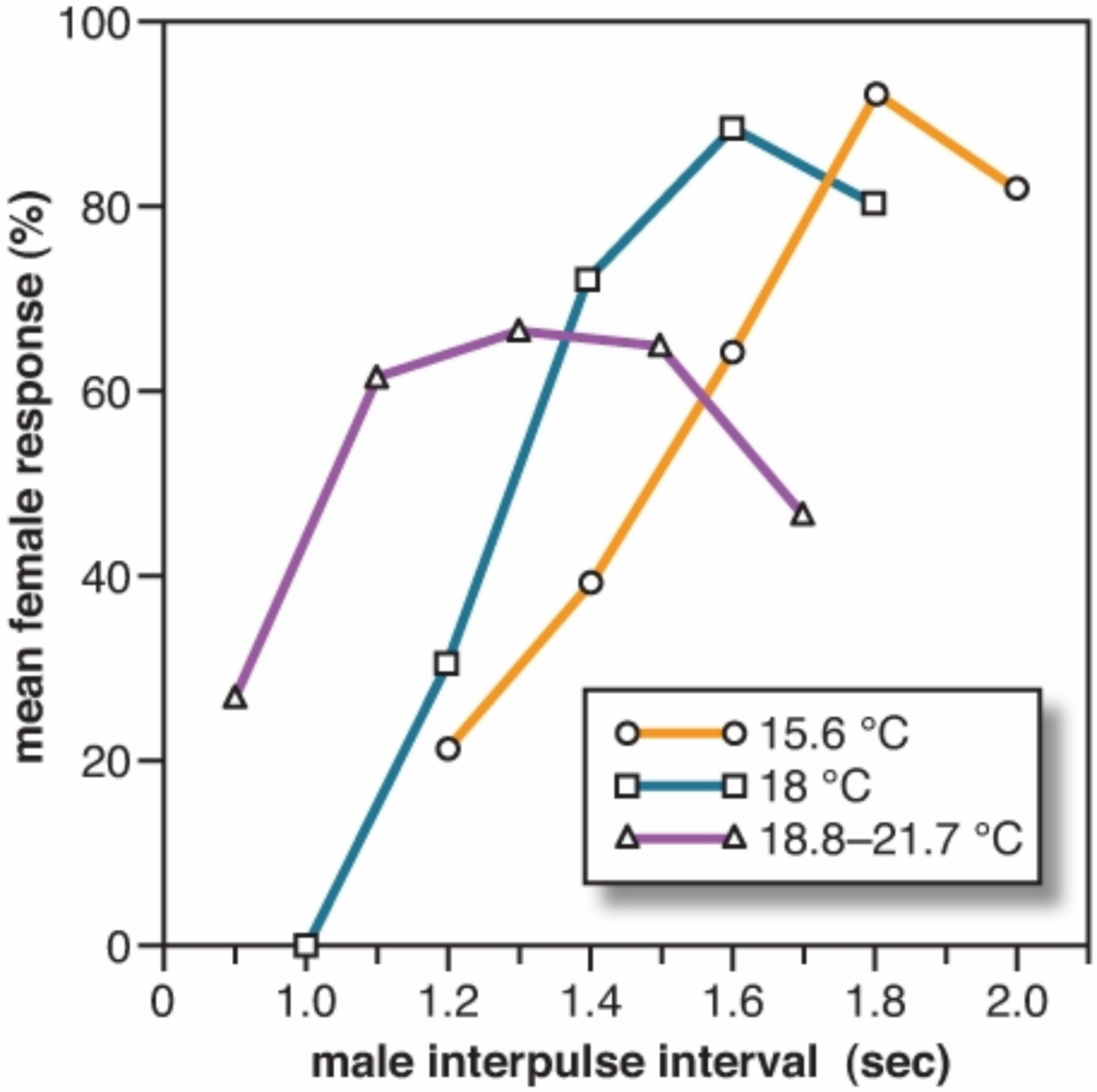


Figure 17.4 Data on the response of female *P. greeni* fireflies to simulated male signals at different temperatures. Male signals were double pulses of light separated by varying IPIs. There were five intervals tested at each temperature. From Michaelidis et al., 2006,

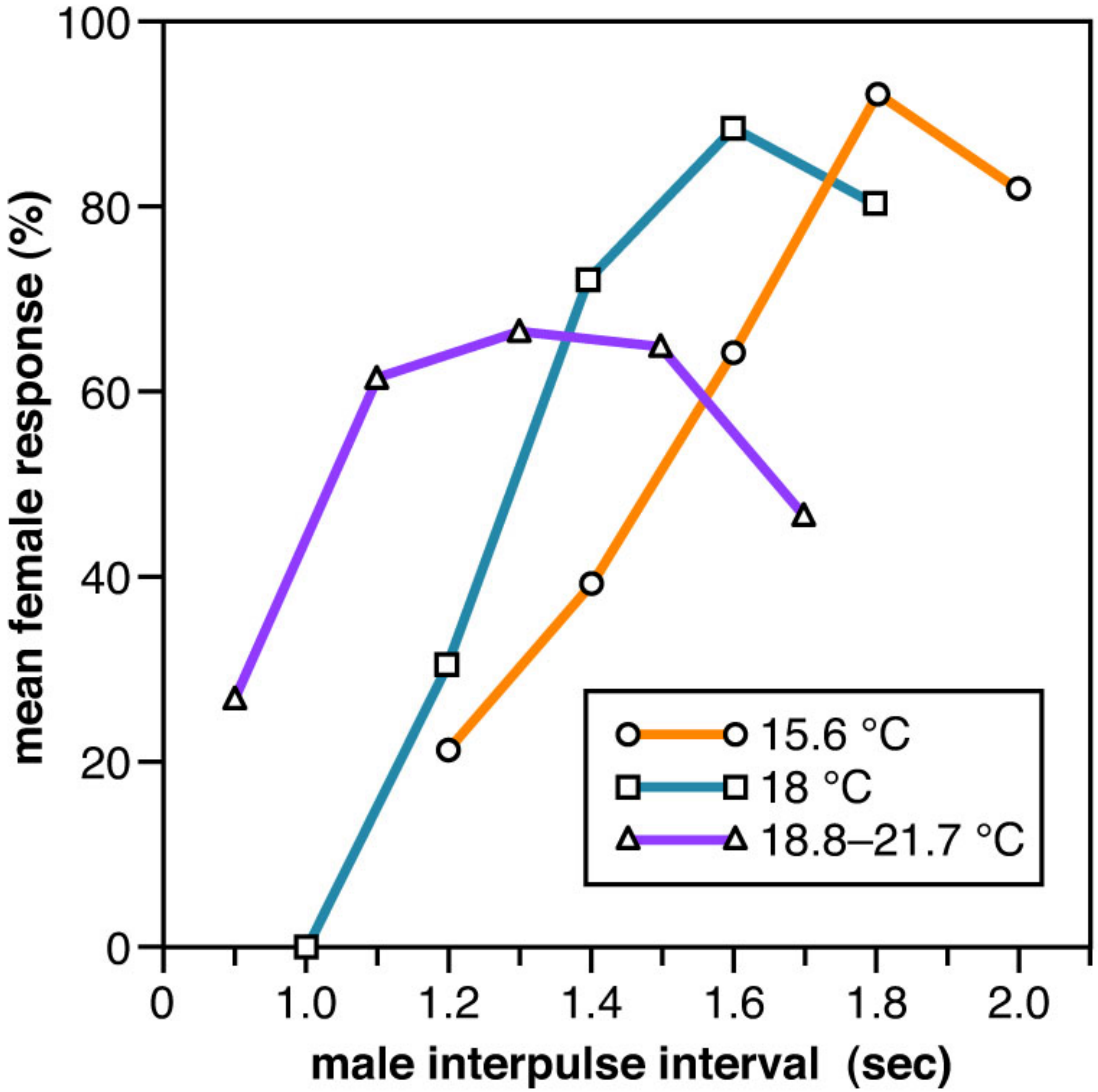


Figure 17.4

Modified from Michaelidis et al. (2006) Figure 5.

7. **Would you expect the mean pulse interval at any temperature to lead to the highest percentage response among females? Why or why not? Is the percentage of females responding greatest at the mean male pulse interval for any temperature or temperature range?**

8. **Why might females respond to a male whose IPI is shorter or longer than the mean IPI?**

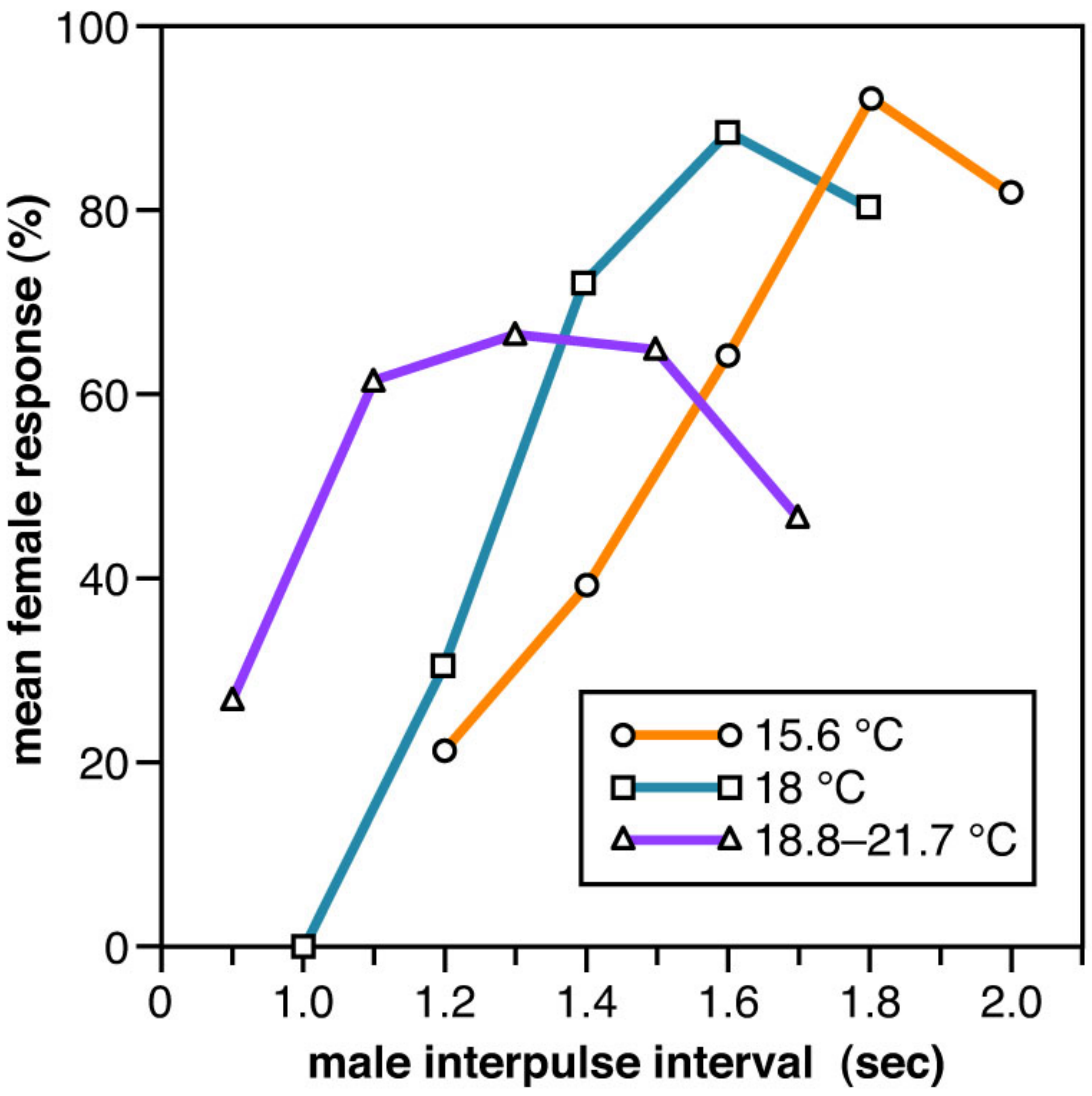


Figure 17.4

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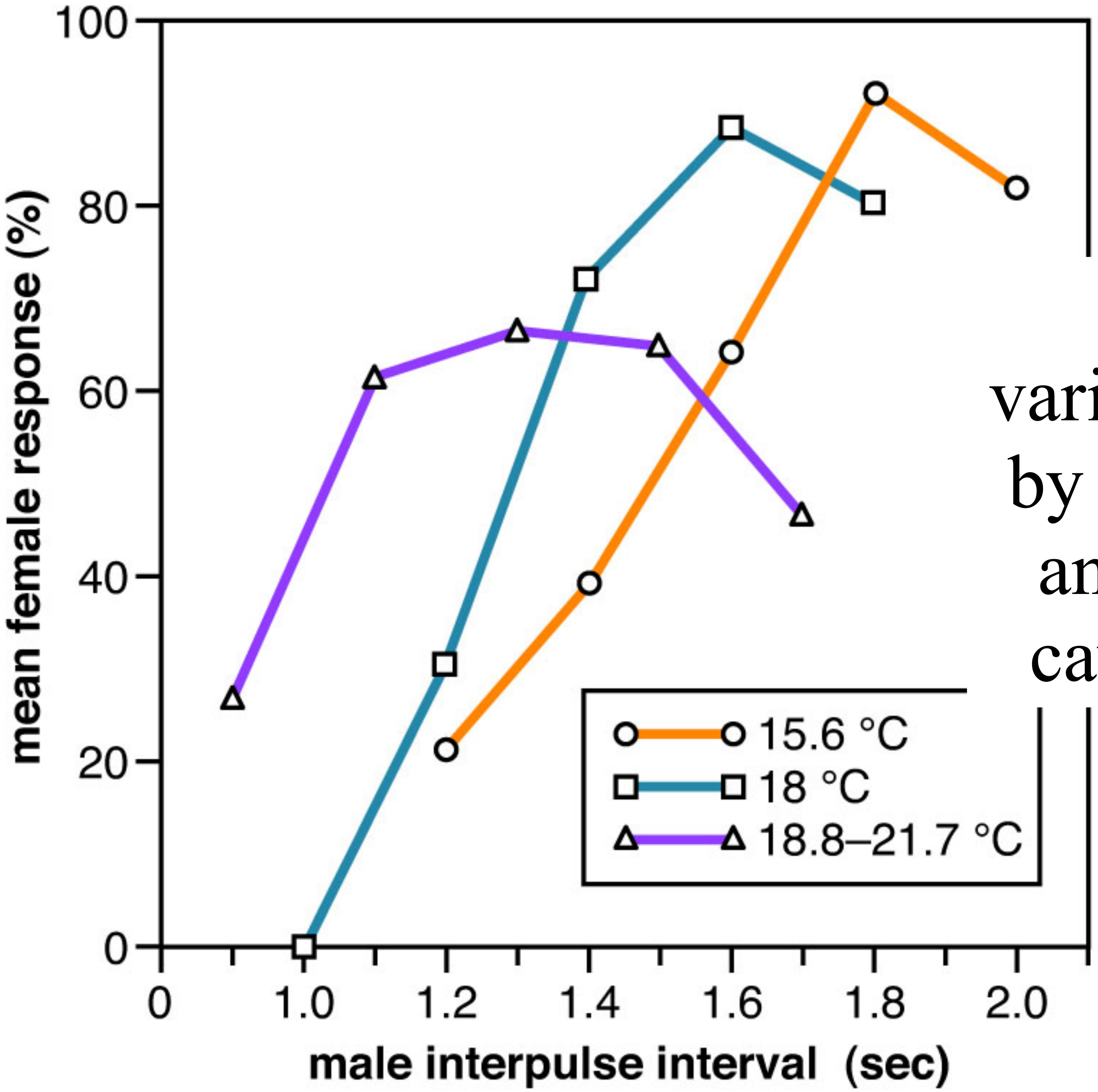
Response of female *P. greeni* fireflies to simulated male signals at different temperatures



Explain variation caused by temperature and variation caused by IPI

Figure 17.4

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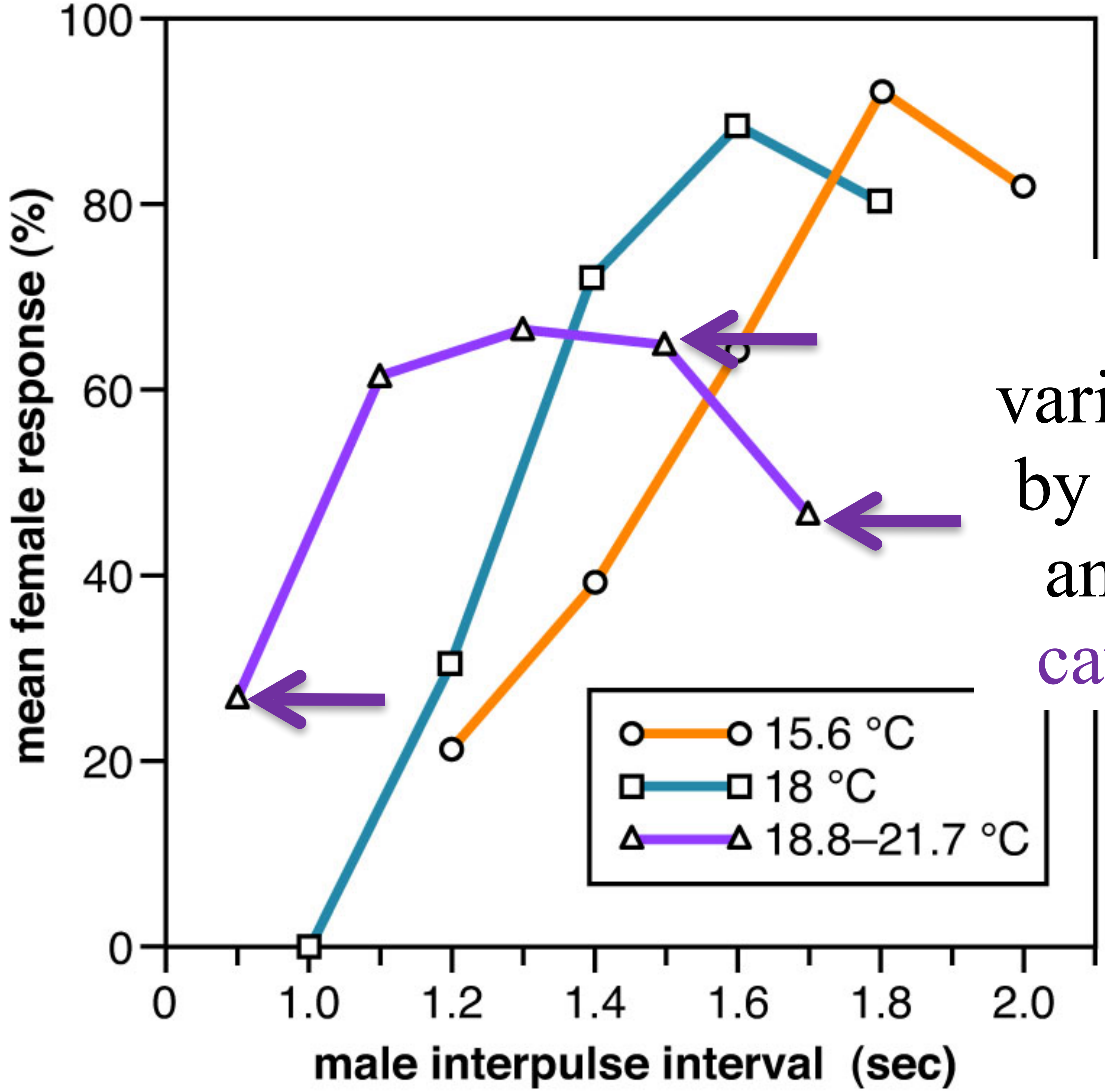
Response of female *P. greeni* fireflies to simulated male signals at different temperatures



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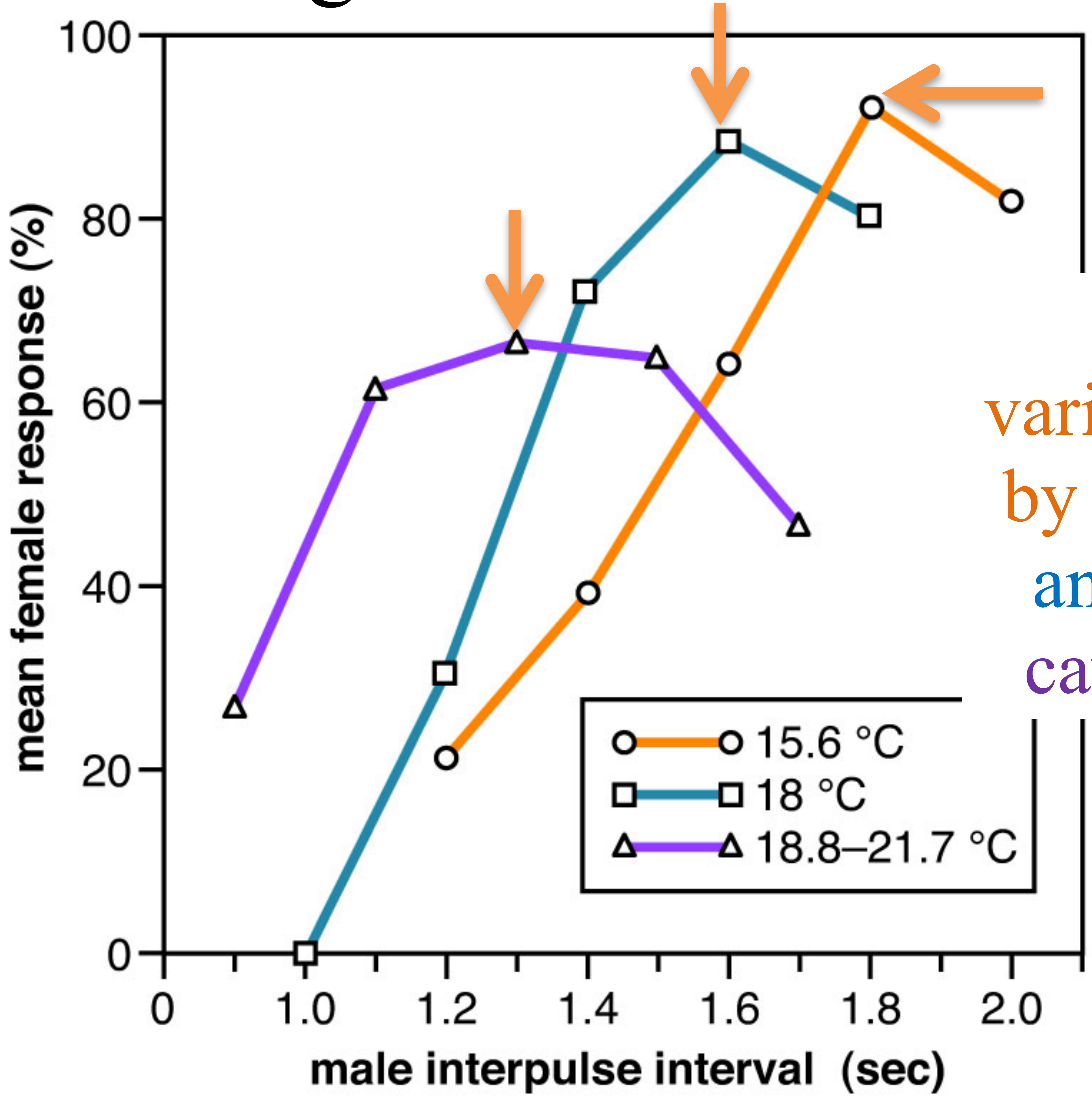
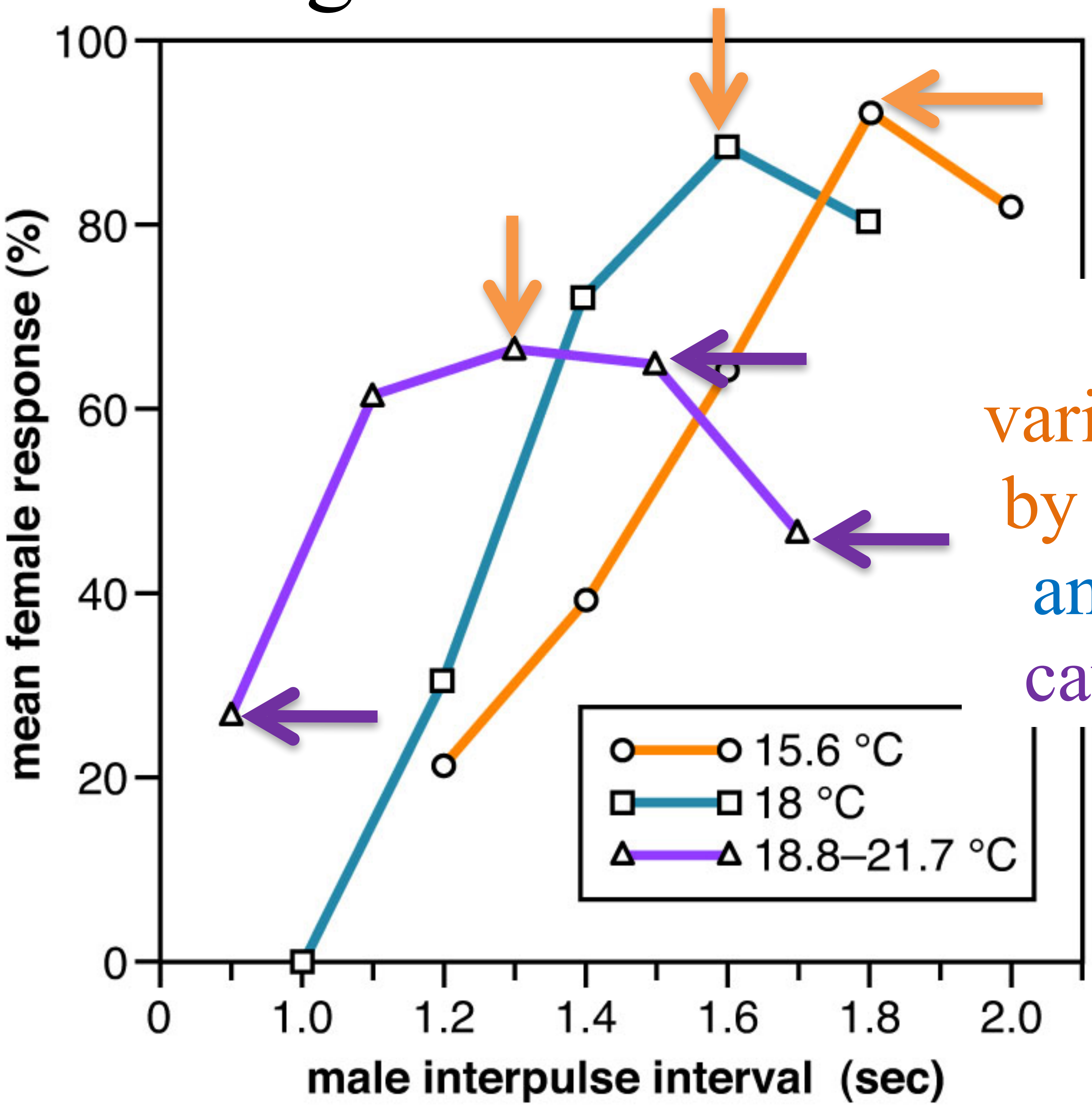


Explain
variation caused
by temperature
and variation
caused by IPI

Figure 17.4

Response of female *P. greeni* fireflies to simulated male signals at different temperatures



Explain variation caused by temperature and variation caused by IPI

Figure 17.4

What about this experiment?

Trifecta

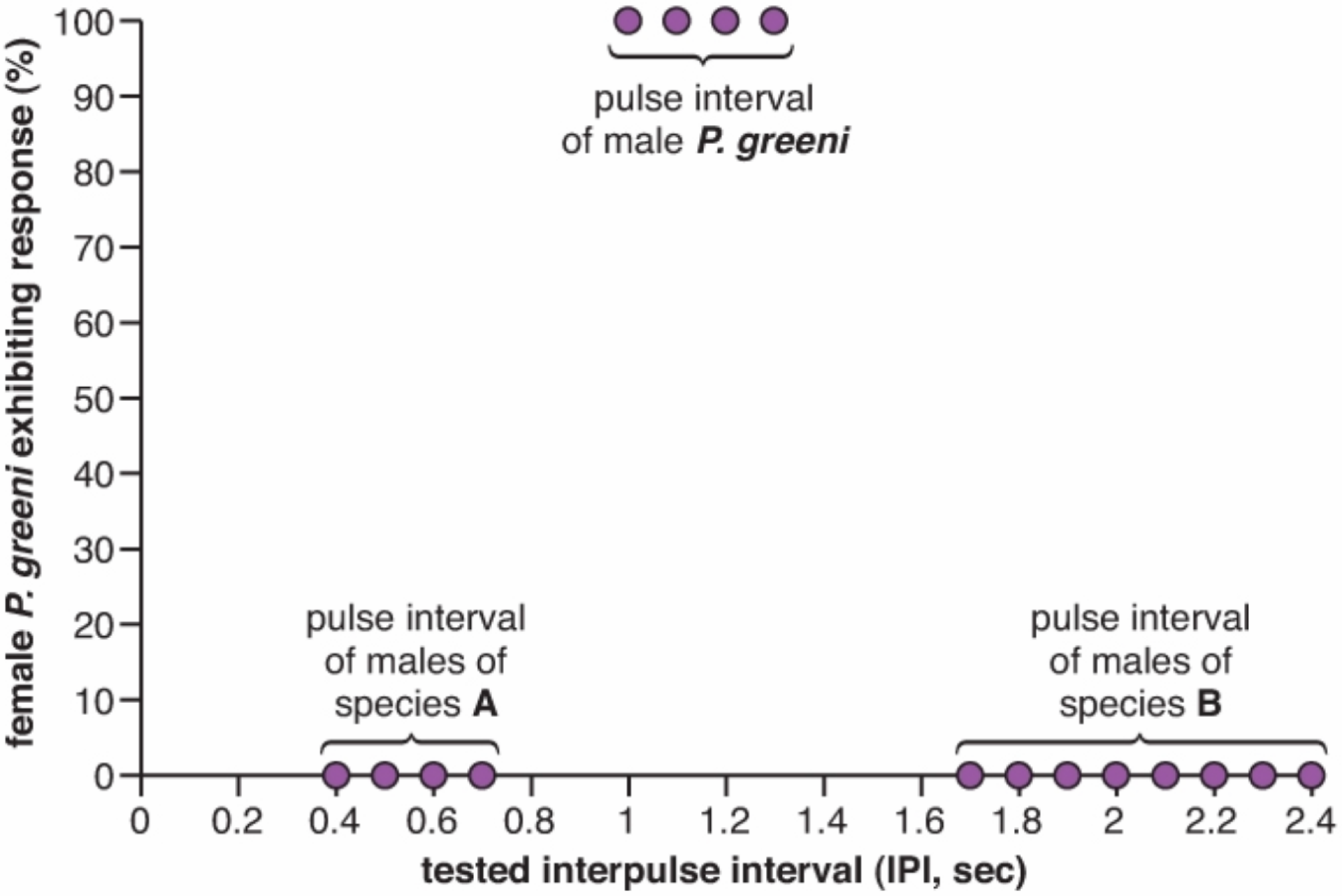


Figure 17.5 Female *P. greeni* were tested for their responsiveness to pulse intervals of varying duration that were known to be found in males of three different species (sample size = 1 to 3 for each IPI tested). The range of pulse intervals for males of each species is indicated by the three different brackets. Data from Lloyd, 1969.

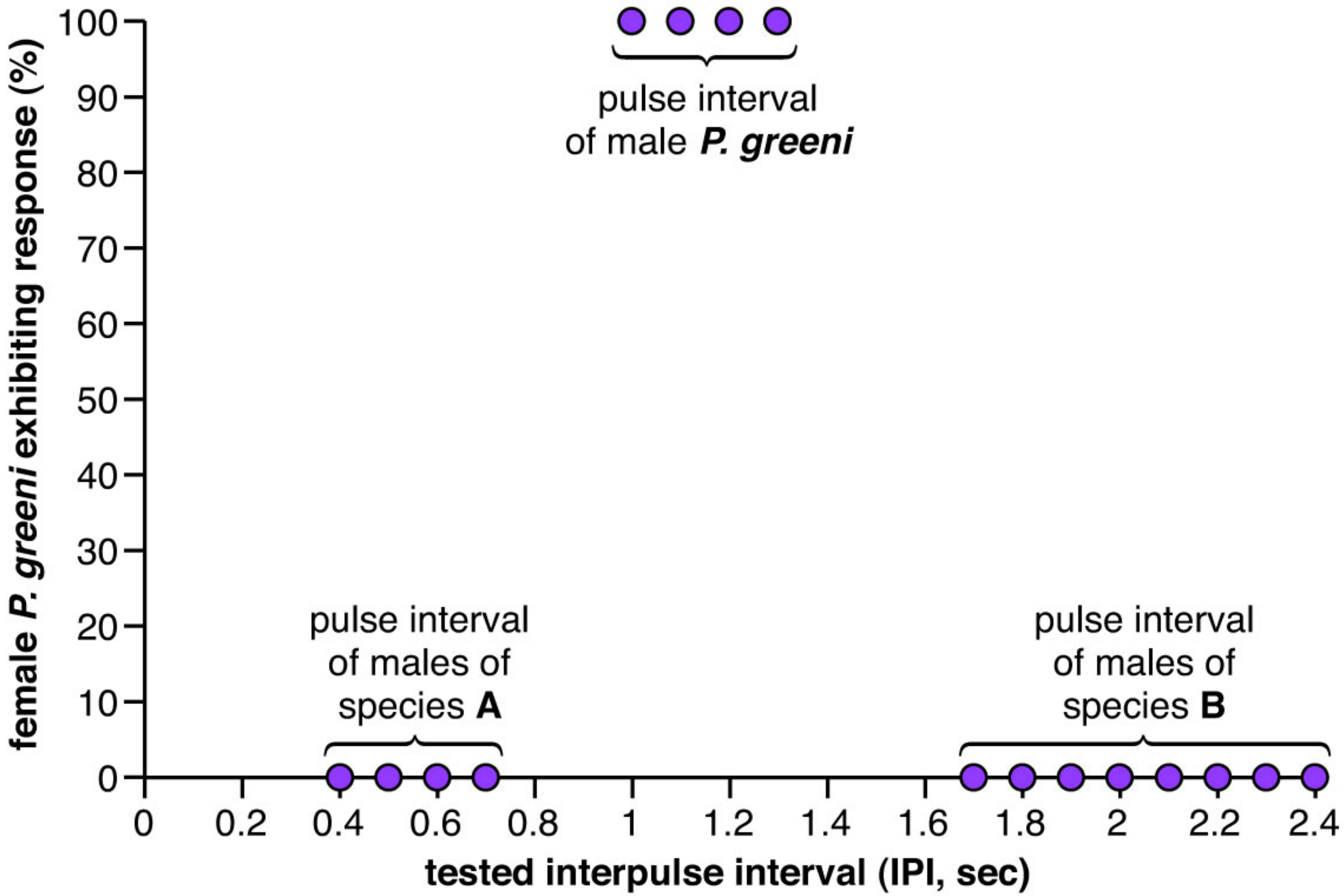


Figure 17.5

Data from Lloyd JE (1969).

Female *P. greeni* tested for responsiveness to varying IPI

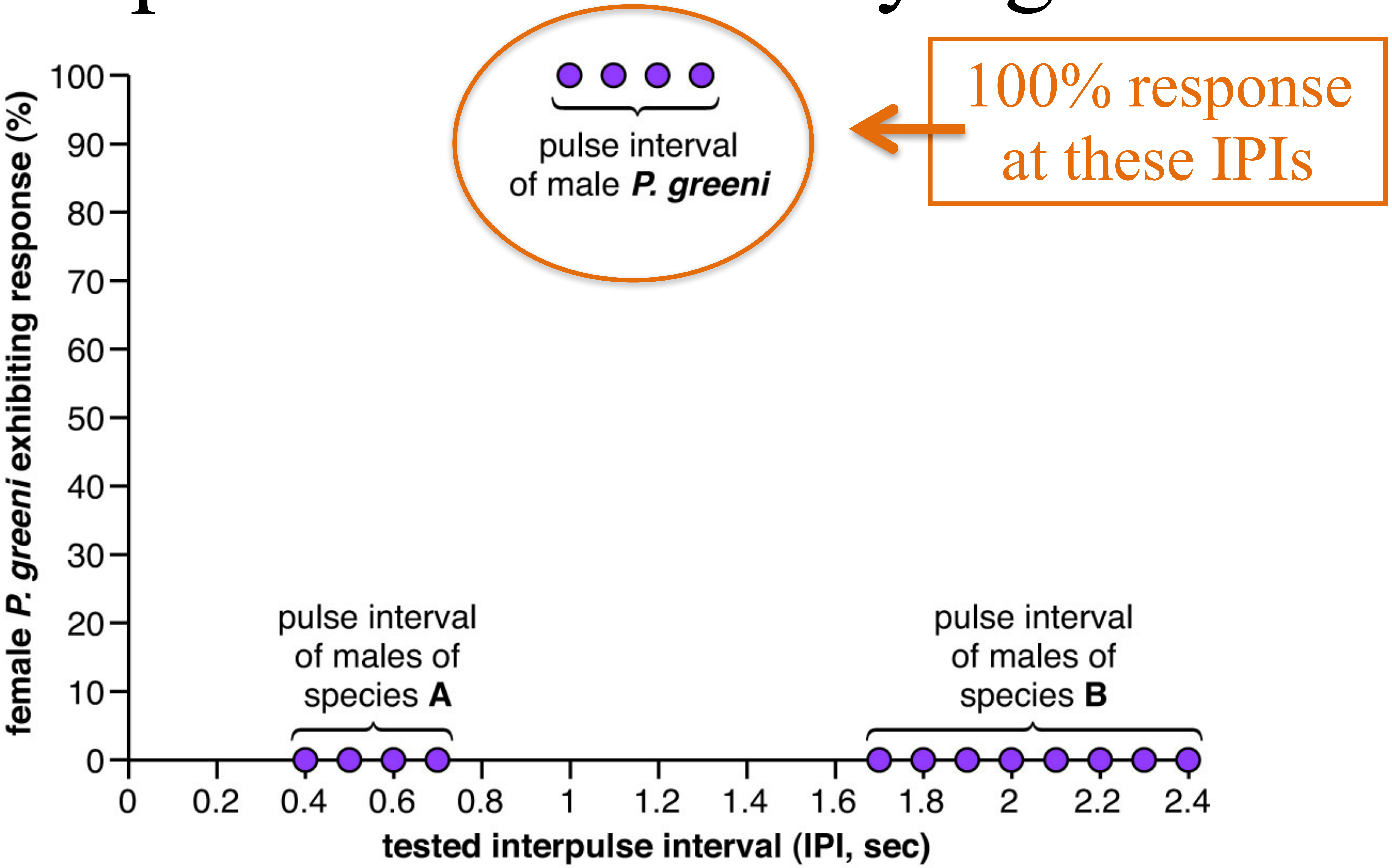


Figure 17.5

Data from Lloyd JE (1969).