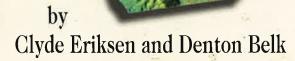
Fairy Shrimps

of California's Puddles, Pools, and Playas



The 25 fairy shrimps found in California

Artemia franciscana Kellogg, 1906 Artemia monica Verrill, 1869 Branchinecta campestris Lynch, 1960 Branchinecta coloradensis Packard, 1874 Branchinecta conservatio Eng, Belk, & Eriksen, 1990 Branchinecta dissimilis Lynch, 1972 Branchinecta gigas Lynch, 1937 Branchinecta lindahli Packard, 1883 Branchinecta longiantenna Eng, Belk, & Eriksen, 1990 Branchinecta lynchi Eng, Belk, & Eriksen, 1990 Branchinecta mackini Dexter, 1956 Branchinecta sandiegonensis Fugate, 1993 Branchinecta sp. - 1 Branchinecta sp. - 2 Branchinecta sp. - 3

Eubranchipus bundyi Forbes, 1876 Eubranchipus oregonus Creaser, 1930 Eubranchipus serratus Forbes, 1876 Linderiella occidentalis (Dodds, 1923) Linderiella santarosae Thiery & Fugate, 1994 Streptocephalus dorothae Mackin, 1942 Streptocephalus sealii Ryder, 1879 Streptocephalus texanus Packard, 1871 Streptocephalus woottoni Eng, Belk, & Eriksen, 1990 Thamnocephalus platyurus Packard, 1879

100

San Francisco brine shrimp Mono Lake brine shrimp pocketed pouch fairy shrimp Colorado fairy shrimp Conservancy fairy shrimp dissimilar fairy shrimp giant fairy shrimp versatile fairy shrimp longhorn fairy shrimp vernal pool fairy shrimp alkali fairy shrimp San Diego fairy shrimp midvalley fairy shrimp winter fairy shrimp mountain fairy shrimp knobbedlip fairy shrimp Oregon fairy shrimp ethologist fairy shrimp California fairy shrimp Santa Rosa Plateau fairy shrimp New Mexico fairy shrimp spinytail fairy shrimp Great Plains fairy shrimp Riverside fairy shrimp beavertail fairy shrimp

FAIRY SHRIMPS OF CALIFORNIA'S PUDDLES, POOLS, AND

art work by Ina Rae Lengyel

cover and maps by Jones & Stokes Associates, Inc.

PLAYAS

by

Clyde H. Eriksen and Denton Belk

As a student at the University of California at Santa Barbara in the early 1950s, I (Clyde Eriksen) often accompanied my professor, Dr. Donald M. Wootton, on collecting forays to terrestrial haunts, intertidal habitats, and, in the winter and spring, to rain pools. On one of my first visits to the magical world of a pool, Don showed me a net-full of gorgeous little redeved creatures he called fairy shrimps. Their beauty and graceful swimming behavior, combined with Don Wootton's enthusiastic field style, caught my attention. Our collecting sites on the coastal plain near the University are now but a distant memory. The pools were drained or leveled, the earth compacted and built upon to provide different living sites, this time for higher hominids meeting the higher demands of higher education.

During those college years of mine I spent parts of each summer back-packing the John Muir Trail along the crest of the High Sierra. In 1953 and 1954, I cajoled Don into going with me to "collect fairy shrimps". He agreed. We went. And the stories, from burro problems in the snow of Donohue Pass to apple fritters baked at the base of Fin Dome, are legendary - but for another telling. We did net fairy shrimps in many a pool. They were forwarded to the desk of an expert in Ohio, never to be seen again. But no matter, Don had "netted" me, and his fairy shrimps have kept my life-long interest!

In August of 1992, I was pleased to visit again with Donald Wootton and tell him of our plans for this book, a book that for me has been 45 years in the making, and for him will not be read. While outlining this manuscript in January of 1993, I received word that Don, like so many of the other of God's creatures that he studied and loved so well, took his last breath. Though it is but a small token in appreciation of Donald Wootton's influence on so many young biologists, and in his

retirement years on numerous "ordinary citizens", we dedicate this book to his service and memory. And may Streptocephalus woottoni, the Riverside fairy shrimp formally named after him in 1990, swim gracefully each rainy season as a tribute to his care for, and our care and consideration of, the life with which we humans share this small planet.

©1999 Clyde H. Eriksen and Denton Belk

Published by Mad River Press, Inc. 141 Carter Lane Eureka, California 95503

Printed by Eureka Printing Company, Inc. 106 T Street Eureka, California 95501

ISBN 0-916422-83-6

ii

Dedication



Donald Wootton Reprinted courtesy of The Idaho Statesman

iii

Contents

DEDICATION		ш
LIST OF FIGURES	(4)	vii
LIST OF MAPS		ix
LIST OF TABLES	a a	· x
PREFACE	4 ²¹	xi
ACKNOWLEDGMENTS		xiii
CHAPTER 1		1
INTRODUCTION		

What are fairy shrimps?	
Who are the relatives of fairy shrimps?	
The where and whys of fairy shrimp haunts	
What good are fairy shrimps?	

CHAPTER 2

BIOLOGY OF FAIRY SHRIMPS: HOW THEY ARE PUT TOGETHER AND HOW THE PARTS WORK

External structures and their functions.	11
Circulatory system	13
Oxygen: its procurement and regulation	13
Water, salts, and liquid wastes: their regulation	17
Reproduction	20
Development of cysts	22
natching	24
Color	27

CHAPTER 3

ECOLOGY OF FAIRY SHRIMPS

Introduction to community ecology The fairy shrimp's aquatic community. Coexistence of species of fairy shrimps What do fairy shrimps eat? What eats fairy shrimps?

CHAPTER 4

STATEWIDE DISTRIBUTION OF FAIRY SHRIMPS

Fairy Shrimps aren't everywhere in Ca How fairy shrimps got where they've g Categorizing California's environment A classification of pool basins where fa Geographic-vegetational regions of Ca Habitat categories and their associated

CHAPTER 5

11

NATURAL HISTORY OF CALIFORNIA'S SPECIES OF FAIRY SHRIMPS

Fairy shrimps of cold-water pools which predictable, and long-lived..... Fairy shrimps of cold-water pools which predictable, and long-lived..... Fairy shrimps of cool-water pools which moderately predictable, and long-liv Fairy shrimps of cool-water pools which less predictable, and short-lived Fairy shrimps of cold- and cool-water predictable to less predictable, and Fairy shrimps of warm-water pools wh less predictable, and long-lived Fairy shrimps of warm-water pools wh less predictable, and short-lived Fairy shrimps of cool- to warm-water predictable, and temporary or perm

iv

Contents

31

·	
S	

57

alifornia	57
got	61
tal diversity: An overview	64
airy shrimps might dwell	66
llifornia	
species of fairy shrimps	70

75

ich are low in dissolved solids,	
ich are low to moderate in dissolved solids,	76
	84
ich are low to moderate in dissolved solids,	
ived	88
ich are low to moderate in dissolved solids,	
	90
r pools which are moderate to great in dissolved solids,	
l long-lived	98
hich are low to moderate in dissolved solids,	
	104
hich are moderate in dissolved solids,	
	106
pools which are great to impressive in dissolved solids,	
nanent	109

			e,
Contents			
	129	÷	Lis
STATUS, INCLUDING ENDANGERMENT, AND CONSERVATION	I	1.1	Family tree of the fairy shrimps
CHAPTER 7	422	1.2	Lateral view of a male Branchin
HOW TO KNOW THE CALIFORNIA FAIRY SHRIMPS	133	1.3	Lateral view of a female Branch
Introduction	133	2.1	Sequence of events in the hatch
Key			•
	167	2.2	Larval stages of fairy shrimps
Glossary	107	3.1	Anterior view of 5th phyllopod
		3.2	Cysts of the California species of
APPENDIX 2	173 🖕	4.1	Drawings by James E. Lynch of
Collecting, Preservation, and Storage		5.1	Drawings by James E. Lynch of
		5.2	Drawing by James E. Lynch of
APPENDIX 3	177	5.3	Drawing by James E. Lynch of
Hatching and Rearing		7.0	Denton identifying a fairy shrin
		7.1	Cercopods of Thamnocephalus
APPENDIX 4	179	7.2	Cercopods of Streptocephalus s
Classification of fairy shrimps and some of their arthropod relatives		7.3	Identifying features of males of
LAST MINUTE NEWS — FAIRY SHRIMP SCIENCE SWIMS ON	182	7.4	Schematic of the head and ante
		7.5	Identifying features of males of
-ITERATURE CITED	183	7.6	Identifying features of males of
NDEX	105	7.7	Identifying features of males of
	195	7.8	Identifying features of males of
	1		
	1	7.9	Identifying features of males of
vi	1		
VI		4	2 S

en dire di La ren

1

ist of Figures

nps and their branchiopod relativesxiv
chinecta lynchi 2
nchinecta lynchi 3
tching of a fairy shrimp cyst25
ood (leg) of a male Branchinecta longiantenna47
es of Eubranchipus
h of Branchinecta gigas73
h of Branchinecta campestris74
of Branchinecta coloradensis
of Branchinecta lindahli116
nrimp
lus platyurus and Branchinecta gigas
lus platyurus and Branchinecta gigas
•
us sealii and Artemia monica141
us sealii and Artemia monica