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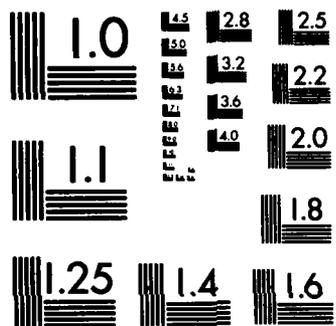
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HUBBS-SEA WORLD RESEARCH INSTITUTE

MARINE SCIENCES
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AQUACULTURE
BIOACOUSTICS

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REPORT ON ONR CONFERENCE ON "DOLPHIN BEHAVIOR
AND COGNITION: COMPARATIVE AND ECOLOGICAL
ASPECTS"

HUBBS-SEA WORLD RESEARCH INSTITUTE
SAN DIEGO, CALIFORNIA 92109: July 6-9, 1983

Final Report: ONR Contract No. N00014-83-G-0011

Prepared by:
Robert Buhr and William E. Evans

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HUBBS-SEA WORLD RESEARCH INSTITUTE

SAN DIEGO, CALIFORNIA 92109

July 6 - 9, 1983

Final Report

Office of Naval Research

Contract No. N00014-83-G-0011

Prepared by:

Robert Buhr
Department of Linguistics
Brown University
Providence, Rhode Island 02912

and

William E. Evans
Hubbs-Sea World Research Institute
1700 South Shores Road
San Diego, California 92109

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November 1983

HSWRI Technical Report No. 83-162



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REPORT ON ONR CONFERENCE ON
"DOLPHIN BEHAVIOR AND COGNITION: COMPARATIVE AND ECOLOGICAL ASPECTS"
HUBBS-SEA WORLD RESEARCH INSTITUTE

SAN DIEGO, CA 92109
JULY 6-9, 1983

A four-day conference sponsored by the Office of Naval Research on dolphin behavior and cognition was held at Hubbs-Sea World Research Institute in July, 1983. This conference was the result of an earlier three-day workshop, also sponsored by the Office of Naval Research, which was tasked with the planning of the conference. The conference had two principal objectives: (1) to survey the "state-of-the-art" of current research in dolphin behavior, cognition, and communication; and (2) to place the results of past and current research into a broader biological and psychological perspective. The conference was attended by 34 participants, including researchers from such disciplines as marine biology, bioacoustics, comparative psychology, cognitive psychology, the neurosciences, linguistics, ethology, primatology, sociobiology, and dolphin training. A list of conference participants is attached.

A keynote address was given by Donald Griffin on problems involved in defining and discussing animal intelligence and consciousness, the conference was divided into ten general topic areas over a three-day period. These were:

(1) Ecology and Evolution of Dolphin Behavior, moderated by F. G. Wood (NOSC, San Diego), with target papers by Bernd Würsig (Moss Landing Marine Laboratories) and Christine Johnson (California State University, Hayward), and commentaries by Jack Bradbury (U.C. San Diego) and John Eisenberg (Florida State Museum);

(2) The Dolphin Brain, moderated by Theodore Bullock (U.C. San Diego), with target papers by Peter Morgane (Worcester Foundation for

Experimental Biology) and Sam Ridgway (NOSC, San Diego), and a commentary by Helen Neville (Salk Institute);

(3) Defining the Perceptual World of Dolphins, moderated by Robert Buhr (Brown University), with a target paper by Harry Jerison (UCLA) and a commentary by Karl Pribram (Stanford University);

(4) Sensory Processing in Dolphins, moderated by William Evans (HSWRI), with target papers by Paul Nachtigall (NOSC, Hawaii) and C. Scott Johnson (NOSC, San Diego), and commentaries by Theodore Bullock and Sam Ridgway;

(5) Communication Processes in Comparative Perspective, moderated by Kenneth Norris (U.C. Santa Cruz), with target papers by William Evans and W. John Smith (University of Pennsylvania), and commentaries by Jeanette Thomas (HSWRI) and Bernd Wursig;

(6) A Panel Discussion on Dolphin Training, with the following as discussants: Bruce Stephens (Sea World, San Diego), Karen Pryor (Rutgers University), Ronald Schusterman (California State University, Hayward); Randy Brill (Brookfield Zoo, Chicago), David Butcher (Sea World, Florida), and Sue Savage-Rumbaugh (Yerkes Primate Research Center);

(7) Dolphin Play and Mimicry, moderated by Paul Nachtigall, with target papers by Douglas Richards (University of Hawaii) and Robert Buhr, and commentaries by Kenneth Norris and Emil Menzel (SUNY, Stony Brook);

(8) Dolphin Cognitive Characteristics in Comparative Perspective, moderated by Louis Herman (University of Hawaii), with target papers by James Wolz (University of Hawaii) and Duane Rumbaugh (Georgia State University), and commentaries by Ronald Schusterman and Thomas Bever (Columbia University);

(9) Language Learning by Dolphins, moderated by Ronald Schusterman, with target papers by Louis Herman and Sue Savage-Rumbaugh, and commentaries by Irene Pepperberg (Purdue University) and Robert Buhr; and

(10) Defining Mammalian Intelligence, moderated by Harry Jerison, with target papers by Emil Menzel and Earl Hunt (University of Washington), and commentaries by William Mason (U.C. Davis) and Donald Griffin (Rockefeller University).

The general consensus of the participants of the conference was that while there are many areas of dolphin behavior and cognition about which little is known, there are certain areas where cross-mammalian comparisons are possible. In the areas of foraging strategies and patterns of social organization, it is becoming clear that dolphin species conform to general mammalian patterns. Moreover, it appears as if further study of types of social interaction in different dolphin species may bear on several important socio-biological questions, including appreciations of cost-benefit analysis to behavior.

Recent research on morphology and neurophysiology of the dolphin brain has yielded more detailed information with which to make cross-mammalian comparisons. In particular, while it now appears that in some ways the dolphin brain is "undeveloped" as compared to primate brains, there are nonetheless certain neurophysiological similarities (as evidenced by evoked-potential research) to humans which bear further investigation.

In addition to state-of-art presentations on sensory processing in dolphins, there was considerable interesting speculation by Professors Jerison and Pribram about the nature of the perceptual world of the dolphin. Jerison broached the possibility that the dolphin's perceptual world may be a more social, communal world than that available to terrestrial mammals. This discussion led into several sessions on cognitive processing

in dolphins, including results of current research on learning, memory, and attention in comparative perspective, and discussion of the implications of vocal and behavioral mimicry and play for assessment of cognitive capacities.

Of special interest in this regard was the panel discussion on training, which included discussion of methodologies used in marine mammal training in a comparative perspective, particularly in comparison with experimental methodologies used in primate research. This panel thus represented the first attempt to put human-dolphin training interactions into a broader framework of formalized inter-species interactions.

The papers in communication processes and dolphin language-learning research were also placed in a comparative perspective, with specific reference to primates and birds. As in other areas, it is now becoming clear that there is enough emerging dolphin data to allow cross-specific comparisons of signalling processes and their underlying cognitive foundation. In particular, there was considerable discussion on the value of the notion of grammar as a device for cross-species analysis of both behavior and cognitive capacities.

The conference closed with general discussion on the biological nature of intelligence. There was general agreement that as amorphous as this concept is, it does have some empirical value, since researchers are once again attempting to formulate a conceptual vocabulary for defining what it means to say that an animal is intelligent.

The conference was significant in several respects. First, it provided a forum for presentation of the most recent research in the areas of dolphin brain research, sensory processing, and cognitive and behavioral research. Second, it created a broad biological framework for integrating this information on an ongoing basis during the conference. Third, it represented the first systematic attempt to integrate research on dolphins

with that on primates and other vertebrates. On all three counts, the conference was successful.

LIST OF PARTICIPANTS AND OBSERVERS
CONFERENCE ON "DOLPHIN BEHAVIOR AND COGNITION:
COMPARATIVE AND ECOLOGICAL ASPECTS"
HUBBS-SEA WORLD RESEARCH INSTITUTE
SAN DIEGO, CA 92109
JULY 6-9, 1983

Thomas Bever
Department of Psychology
Columbia University
New York, NY 10027

Cognition and language and
everything in between

Ann E. Bowles (observer)
Hubbs-Sea World Research
Institute
1700 South Shores Road
San Diego, CA 92109

Avian communication, auditory
perception, sound production

Jack Bradbury
Department of Biology
University of California, San Diego
La Jolla, CA 92093

Socio-ecology in vertebrates

Gary Bradshaw (observer)
Kewalo Basin Marine
Mammal Lab
University of Hawaii
1129 Ala Moana
Honolulu, HI 96814

Randy Brill
Brookfield Zoo
Brookfield, IL 60513

Training and sensory processes

Robert Buhr
Department of Linguistics
Brown University
Providence, RI 02912

Animal communication and cognition;
neurolinguistics and neuropsychology
biology of language

Theodore Bullock
Department of Neurosciences
University of California, San Diego
La Jolla, CA 92093

Comparative neurology; physiology
of central sensory processing;
invertebrates, fish, and all
vertebrate classes.

David Butcher
Department of Animal Behavior
Sea World, Inc.
7007 Sea World Drive
Orlando, FL 32809

Environmental intrinsic motivation

John Eisenberg
Florida State Museum
University of Florida
Gainesville, FL 32611

Animal communication, socio-ecology

William Evans
Hubbs-Sea World Research Institute
1700 South Shores Road
San Diego, CA 92109

Animal behavior/bioacoustics/
functional morphology

Lisa Ferm (observer)
Hubbs-Sea World Research Institute
1700 South Shores Road
San Diego, CA 92109

Sheldon R. Fisher (observer)
Hubbs-Sea World Research Institute
1700 South Shores Road
San Diego, CA 92109

Bioacoustics, communication

Kimberley Goodrich (observer)
Hubbs-Sea World Research Institute
1700 South Shores Road
San Diego, CA 92109

Cetacean behavior
and communication

Donald R. Griffin
The Rockefeller University
1230 York Avenue
New York, NY 10021

Cognitive ethology

Henry Halff (observer)
Personnel and Training
Research Program
Code 442 PT
Arlington, VA 22212

Louis Herman
Department of Psychology
University of Hawaii
2430 Campus Road
Honolulu, HI 96822
and
Kewalo Basin Marine Mammal Laboratory
University of Hawaii
1129 Ala Moana
Honolulu, HI 96822

Cetacean behavior; animal
cognition and communication

Earl Hunt
Department of Psychology
University of Washington
Seattle, WA 98195

Human cognition - formal
models of thought

Harry Jerison
Department of Psychiatry
University of California
760 Westwood Plaza
Los Angeles, CA 90024

Evolutionary biology of brain
and cognitive behavior

Christine Johnson
Department of Psychology
California State University
Hayward, CA 94542

Dolphin social behavior,
communication, cognition

C. Scott Johnson
Naval Ocean Systems Center
Code 5102
San Diego, CA 92152

Dolphin hearing and bioacoustics

John Lilly (observer)
Human/Dolphin Foundation
P.O. Box 4172
Malibu, CA 90265

Brain, mind, communication, cognitive
central processing, mental telepathy
Physiology, neurophysiology, self
analysis

William Mason
Department of Psychology
University of California
Davis, CA 95616

Primate social behavior

Emil Menzel
Department of Psychology
State University of New York
Stony Brook, NY 11794

Primate behavior

Peter Morgane
 Worcester Foundation for
 Experimental Biology
 222 Maple Avenue
 Shrewsbury, MA 01545

Comparative and evolutionary
 anatomy of brain CNS plasticity -
 neuronal organization of cortex

Paul Nachtigall
 Naval Ocean Systems Center
 P.O. Box 997
 Kailua, HI 96734

Learning and sensory processes
 of marine mammals

Helen Neville
 The Salk Institute
 P.O. Box 85800
 San Diego, CA 92138

Human neuropsychology

Kenneth Norris
 Center for Coastal Marine Studies
 University of California
 Santa Cruz, CA 95064

Cetacean behavior

Irene Pepperberg
 Department of Biological Sciences
 Purdue University
 West Lafayette, IN 47907

Interspecies communication;
 referential vocalizations in the
 gray parrot

Karl Pribram
 Department of Psychology
 Stanford University
 Stanford, CA 94305

Neuropsychology: Brain/behavior
 relationships

Karen Pryor
 44508 1st Street, SE
 North Bend, WA 98045

Learning and social behavior
 in marine mammals

Douglas Richards
 Department of Psychology
 University of Hawaii
 2430 Campus Road
 Honolulu, HI 96822
present address:
 Booz-Allen & Hamilton
 4330 East West Highway
 Bethesda, MD 20814

Cetacean cognition and communication
 acoustic communication

Sam H. Ridgway
 Naval Ocean Systems Center
 Code 5142
 San Diego, CA 92152

Cetacean physiology, brains, sounds

Duane Rumbaugh
 Department of Psychology
 Georgia State University
 Atlanta, GA 30303

Comparative psychology,
 Primate learning and cognition,
 Requisites to first language skills

Sue Savage-Rumbaugh
 Yerkes Regional Primate
 Research Center
 Emory University
 Atlanta, GA 30322

Animal cognition,
 Human and animal linguistic
 communication

Ronald Schusterman
 Department of Psychology
 California State University
 Hayward, CA 94542

Animal cognition,
 Marine Mammal communication,
 Pinniped behavior

W. John Smith
 Department of Biology
 University of Pennsylvania
 Philadelphia, PA 19104

Communication and all other
 aspects of social behavior;
 all vertebrate spp.

Bruce Stephens
 Department of Animal Behavior
 Sea World, Inc.
 1720 South Shores Road
 San Diego, CA 92109

Dolphin behavior

Jeanette Thomas
 Hubbs-Sea World Research Institute
 1700 South Shores Road
 San Diego, CA 92109

Vocal communication in marine
 mammals

James Wolz
 Department of Psychology
 University of Hawaii
 2430 Campus Road
 Honolulu, HI 96822
 and
 Kewalo Basin Marine
 Mammal Lab
 University of Hawaii
 1129 Ala Moana
 Honolulu, HI 96814

Comparative psychology, cetacean
 behavior, animal learning and memo

Forrest G. Wood
Naval Ocean Systems Center
Code 51
San Diego, CA 92152

Cetacean evolution, behavior

Dr. David Woods (observer)
Veterans Admin. Medical Ctr.
(612/127)
150 Muir Road
Martinez, CA 94553

Human neuropsychology,
evoked potentials

Donald Woodward (observer)
Physiology and Neurobiology
Research Program
Code 441 NP
Office of Naval Research
Arlington, VA 22217

Bernd Wursig
Moss Landing Marine Landing
Moss Landing, CA 95039

Cetacean behavior and
social organization

Schedule for Conference on
"Dolphin Behavior and Cognition: Evolutionary and Ecological Aspects"
Hubbs-Sea World Research Institute
San Diego, CA 92109

July 6-9, 1983

Wednesday
July 6

5:30-7:30 pm Hosted wine and cheese party orientation for conference participants
- (Atlantis restaurant patio)

Thursday
July 7

8:00 am Welcoming Address: William Evans (HSWRI)
Keynote Address: Donald Griffin (Rockefeller University)
"Defining the Animal Mind"

9:00 Ecology and Evolution of Dolphin Behavior
Moderator: F. G. Wood (NOSC, San Diego)

Target papers:

9:05 Bernd Würsig (UC Santa Cruz)
Delphinid Foraging Strategies

9:30 Kenneth Norris (UC Santa Cruz)
Patterns of Social Organization and Social Behavior

Commentaries:

9:35 Jack Bradbury (UC San Diego)
9:50 John Eisenberg (Florida State Museum, Gainesville)

10:05 Discussion:

10:20 Coffee break

10:30 The Dolphin Brain
Moderator: Theodore Bullock (UC San Diego)

Target papers:

10:35 Peter Morgane (Worcester Foundation for Experimental Biology)
Comparative Anatomy of the Dolphin Brain

11:05 Sam Ridgway (NOSC, San Diego)
Neurophysiological Studies of the Dolphin Brain

Commentaries:

- 11:30 Robert Brownell (Smithsonian Institution, Washington)
 11:45 Helen Neville (The Salk Institute, La Jolla)
 12:00 Discussion
- 12:15 Lunch break
- 2:00 pm Defining the Perceptual World
- Target paper:
- 2:00 Harry Jerison (UC Los Angeles)
 Perceptual Worlds in Mammalian Evolution
- 2:25 Commentator:
 Karl Pribram (Stanford University)
- 2:40 Discussion
- 3:00 Coffee break
- 3:15 Sensory Processing in Delphinids
 Moderator: W. E. Evans (HSWRI)
- Target papers:
- 3:20 Paul Nachtigall (NOSC, Hawaii)
 Mechanisms of Mechanical, Visual and Tactile Processing
- 3:45 C. Scott Johnson (NOSC, San Diego)
 Audition and Echolocation
- Commentaries:
- 4:10 Theodore Bullock (UC, San Diego)
 4:25 Sam Ridgway (NOSC)
- 4:40 Discussion
- 5:00 Adjourn
- 8:00-10:00 - Informal discussion groups at HSWRI. Topics of the day:
 Ecology and Evolution of Dolphin Behavior, the Dolphin
 Brain, Defining Perceptual World, Sensory Processing
- Discussion

Friday
July 8

- 8:30 am Communication Processes in Comparative Perspective
 Moderator: *Kenneth Norris (UC Santa Cruz)
- Target papers:
- 8:35 William Evans (HSWRI)
 The multi-modal communication system of Delphinids
- 9:00 Frank Awbrey - Research on the function of singing (calling)
 in animals
- Commentaries:
- 9:25 (to be named)
- 9:40 Jeanette Thomas (HSWRI)
- 9:55 Discussion
- 10:15 Coffee break
- 10:30 Panel Discussion: Dolphin Training and Teaching
 Moderator: Bruce Stevens (Sea World)
- Participants: *Karen Pryor, Ron Schusterman, Randy Brill,
 Dave Butcher, Sue Savage-Rumbaugh
- 11:45 Discussion
- 12:00 Lunch break
- 2:00 pm Dolphin Cognitive Capacities in Comparative Perspective
 Moderator: *Paul Nachtigall (NOSC, Hawaii)
- Target papers:
- 2:05 Robert Buhr (Brown University and HSWRI)
 Dolphin Play Behavior and Its Cognitive Implications
- 2:30 Douglas Richards (University of Hawaii)
 Dolphin Vocal Mimicry and Imitation
- Commentaries
- 2:55 Roger Gentry (UC Santa Cruz)
- 3:10 Jack Bradbury, (William Mason, U.C. Davis alternate)
- 3:25 Discussion

*Alternate moderator

3:45 Dolphin Cognitive Characteristics in Comparative Perspective (II)
Moderator: Louis Herman (University of Hawaii)

Target papers:

3:50 James Woltz (University of Hawaii)
Experimental Assessment of Cognitive Capacities of Dolphins

4:15 Duane Rumbaugh (Georgia State University)
Toward a Comparative Framework for Mammalian Learning

Commentaries

4:40 Ronald Schusterman (California State University, Hayward)

4:55 Earl Hunt (University of Washington)

5:10 Discussion

5:30 Adjourn

8:00-10:00 Informal discussion groups on topics discussed during the day.

Saturday
July 9

8:30 am Language Learning by Dolphins in Comparative Perspective
Moderator: Ronald Schusterman (Cal State, Hayward)

Target papers:

8:35 Lou Herman (University of Hawaii)
Dolphin Language Learning: Current Status

9:00 Sue Savage-Rumbaugh (Yerkes Primate Laboratory)
Chimpanzee Language Learning: Current Status

Commentaries:

9:25 Duane Rumbaugh

9:40 Robert Buhr (Brown University and HSWRI)

9:55 Discussion

10:15 Coffee break

10:30 Defining Mammalian Intelligence
Moderator: (Harry Jerison, UC Los Angeles)

Target papers:

- 10:35 Emil Menzel (SUNY Stony Brook)
Non-human Intelligence from a Primate Perspective
- 11:00 Earl Hunt (University of Washington)
Criteria for Defining Intelligent Behavior
- Commentaries:
- 11:25 William Mason (UC Davis)
11:40 *Donald Giffin (Rockefeller University)
11:55 *Harry Jenson
- 12:10 Discussion
- 12:30 Lunch break
- 2:00-5:00 pm General overview and adjournment

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A four-day conference sponsored by ONR on dolphin behavior and cog- nition was held July 6-9 in San Diego, California. Thirty-four scientists representing the disciplines of neurophysiology, animal behavior, bio- acoustics, sociobiology and cognitive ethology participated. The objectives of the conference were to 1) survey the current research on dolphin behavior, cognition and communication and 2) place the results of past and		

20. (continued)

current research into a broader biological and psychological perspective. The conference was divided into 10 sections each with two target papers and two commentaries addressing the aforementioned objectives. ↑

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