Appendix C

Evaluation of Nocturnal Migration Study

The information in Appendix C was submitted by ABR, Inc., on behalf of the Wintu Audubon Society of Redding, CA. The information does not necessarily reflect the analysis and conclusions of Shasta County or ICF Jones & Stokes.

EVALUATION OF THE NOCTURNAL BIRD MIGRATION STUDY PERFORMED BY ABR, INC. ON HATCHET RIDGE, SHASTA COUNTY, CALIFORNIA

In its response to the draft EIR for the proposed Hatchet Ridge wind power project, Wintu Audubon Society of Redding, California, noted the inadequacies of bird studies performed at the site and incorporated in the EIR. In particular, the absence of any studies of actively migrating birds during both day and night, especially under adverse weather conditions that could increase risk of collision with turbines and other structures was noted as an important deficiency.

Subsequent to the submission of the EIR and the Wintu Audubon response thereto, a radar study of nocturnal migration performed at the Hatchet Ridge site by ABR, Inc. of Forest Grove, Oregon, has been placed on the record. This study presents data obtained over 36 nights between 7 September and 15 October, 2007, with a marine radar stationed at two sites on the ridge. I have been asked by Wintu Audubon to evaluate this study and its results with respect to their adequacy to address the concerns raised by Wintu Audubon in its original response to the EIR.

Technology and Analysis Employed in the Study – The equipment and methods employed in this study seem to be in line with current standards in the industry. The data appear to have been collected properly and have been analyzed appropriately. The interpretations of the results presented by ABR are mostly straightforward and reasonably conservative. There are a number of important cautionary statements and caveats contained within the ABR report that should be noted.

As noted in the ABR study, radar has a number of inherent limitations as a source of the kind of information needed for a thorough bird collision risk assessment. First, radar provides very little information concerning the identity of the bird targets presented on its arrays (indeed, it is rarely certain that the targets are even birds). A target that appears large on the radar screen could be the reflection of a single large bird or the reflection of a large flock of small birds. In short, one cannot be certain whether one is detecting swans or sparrows. Second, radar by itself provides no reliable information on the number of birds being detected. Radar energy is emitted in pulses. Each pulse encompasses a given volume of airspace (referred to as the radar pulse volume). Whenever the volume of reflective material (birds, bats, insects, rain drops) within that pulse volume reaches the threshold for detection by the radar, a target or echo will be produced on the radar display. Adding any number of additional reflectors to that pulse volume will not change the appearance of the display. A very weak echo likely indicates a small reflector, although other factors complicate this simple relationship (e.g., the angle at which a bird is flying with respect to the radar beam). A large echo or target, on the other hand, could represent a single large bird, a small flock of medium-sized birds, or a large flock of small birds. In reality, most migratory flights comprise a mixture of flocked and more dispersed migrants. Without some independent data on the distribution of flock sizes within the migrant population aloft, estimating the actual number of birds passing overhead is impossible. This problem has plagued radar studies of bird migration from

their beginnings and where flocked migrants are involved, there is still no satisfactory solution.

Impact studies of bird migration often employ thermal imaging technology or night vision equipment as an independent source of information on the identities of birds detected by radar. Such information would have been useful in this study to shed some light on the types of birds being detected, to confirm that the targets were in fact birds, and to provide some information on flocking and flock sizes. Similarly, it would be useful to have audio recordings of nocturnal flight calls from birds passing overhead. Such recordings can provide the most unambiguous feasible data on the identity of the birds being detected.

The altitudinal distribution of nocturnal migrants – In terms of the risk of migratory bird collisions with wind turbines, we are obviously concerned with birds flying at the lowest altitudes AGL, i.e., within the area occupied by rotors and towers. Using radar to attempt to estimate the number or proportion of birds flying very near the ground can be fraught with problems. The most serious of these is that radar energy can be reflected from objects on the ground, producing echoes or targets on the display called "ground clutter". Ground clutter can completely obscure echoes from birds or bats flying in that portion of the airspace nearest the ground. Although the report states (p.16) that ground clutter at the study sites was minimal, no photos of the radar ppi are presented to document this, and the authors noted that the antenna was elevated 15° above horizontal during surveillance operation in order to get the beam above most of the ground clutter. If ground clutter is significant within 15° of the ground, estimates of the numbers of presumed bird targets in the lowest altitudinal bins presented in the study will not be reliable and will likely be biased on the low side.

In order to be compelling concerning the numbers of bird targets in the lowest altitudes AGL, the study needs to present data on the detectability of birds flying at the lowest altitudes, precisely how altitude measurements of targets were made, the nature and dimensions of the sampling space at the lowest altitudes, the minimum distance at which the radar can detect birds of a given size, and some estimates of the error associated with the altitude measurements. Because birds flying below 250 m AGL, where collision is likely, are the most critical, the reliability of and biases inherent in the low-altitude target density estimates need to be addressed.

Timing of the study and weather conditions – The dates of the study were selected to correspond with the presumed peak of passerine migration in the region (Executive Summary, p. 5). As the study notes (p. 31), there is a general paucity of information on nocturnal migration in the western United States and that this warrants "the cautious interpretation of results." Passerine migration in this region of inland, northern California is generally rather diffuse and of relatively low magnitude compared to many localities in the eastern United States, for example. However, this region is characterized by very large migratory movements of sandhill cranes, tundra swans, several species of geese, and numerous species of ducks and shorebirds traveling between breeding areas and major overwintering sites in the Central Valley of California and the Pacific coast.

Without compelling evidence to the contrary, one can make the argument that it is these species that would be at the greatest risk of collision with wind turbines on Hatchet Ridge.

Importantly, the migration of most of these waterbirds occurs late in the fall season and well into winter when the probability of encountering unfavorable weather in the form of low clouds or fog over the ridge is greater. The report itself notes (p.33) "….the need to understand how nocturnal migrants respond to fog and low ceiling height conditions is warranted." Indeed, this is the most critical inadequacy of this study. The data were collected during a time of the year prior to the main migration period of large, flocked waterbirds, and the data were collected entirely under typically good weather conditions. It is when poor visibility conditions coincide with a large migration of birds that major mortality is most likely to occur. Those are the conditions that need to be studied, but have not been. Especially in the late fall and into the winter, migrations of water birds are often triggered by Pacific storm systems. It is these situations in which large numbers of birds find themselves flying in low cloud cover or fog, the conditions in which flocks of large birds numbering in the hundreds might pass over the ridge within the airspace occupied by the turbines.

Recommended studies

The ABR study presents a large amount of information. While perhaps interesting in its own right, much of that information is largely irrelevant to the goal at hand, i.e., to assess the potential for migrating birds to collide with the wind turbines and associated structures. Because the study was of relatively short duration and took place on nights with little variation in weather conditions, the analysis tells us nothing about what might happen at other times or under other conditions that are likely to occur.

Studies are needed that cover the entire fall and spring migration seasons. At this location, "fall" migration extends well into winter (through December and even into January). Both nocturnal and diurnal migration needs to be examined. Sandhill cranes are diurnal migrants, and tundra swans and geese often migrate both day and night. Low ceiling conditions atop Hatchet Ridge will not be confined to the nighttime period. During these studies, particular emphasis should be placed on understanding the flight behavior of birds under poor visibility conditions at the ridge-top. If there is sufficient moisture in the clouds or if there is precipitation, radar will be unlikely to be useful in detecting birds. Under these conditions, only visual observations or auditory recording are likely to provide the necessary information. It must be emphasized that although the kinds of data described here are the most difficult to obtain, they are the only ones that will enable a reasonable assessment of the risk of mortality to migrating birds.

The ABR study suggested a larger number of birds passing the Saddle site versus the North site. Inasmuch as the Saddle is located near the center of the proposed wind turbine array, future work should concentrate at that site.

Kenneth P. Able, Professor Emeritus

Department of Biological Sciences
University at Albany, State University of New York
Albany, New York 12222

Present address:
Bob's Creek Ranch
535-000 Little Valley Road
McArthur, California 96056

CURRICULUM VITAE

KENNETH P. ABLE, Professor
Department of Biological Sciences
The University at Albany
State University of New York
Albany, New York 12222

Office phone: 518-442-4330
FAX phone: 518-442-4767
Home phone: 518-872-1791
e-mail: kpa@cnsunix.albany.edu

PERSONAL DATA:

Born, February 5, 1944, Louisville, Kentucky. Married. One child.

EDUCATION:

B.A. University of Louisville, 1966 (Biology)
M.S. University of Louisville, 1968 (Biology)
Ph.D. University of Georgia, 1971 (Zoology)

HONORS:

Sigma Pi Sigma (Physics); Woodcock Soc., Univ. of Louisville (univ.-wide honor society); N.V. LeBre Award (Biology); Ford Fndn. Accelerated M.S. Degree Program; Phi Kappa Phi; Sigma Xi; Marcia Brady Tucker Award, Amer. Ornithol. Union, 1970; Wilson Award, Wilson Ornithol. Soc., 1971; Fellow, Amer. Ornithologists' Union, 1981; Corres. Fellow, Deutsche Ornithologen-Gesselschaft, 1988; Fellow, Animal Behavior Soc., 1993; work featured in National Geographic, Aug., 1979, June, 1991; New York Times, 9 Oct. 1990, 28 Sept. 1993; Washington Post, 25 Mar. 1991; New Scientist, 4 Sept. 1993, 9 Nov. 1996; Science News, 7 Aug. 1993; J. NIH Research, Nov. 1993; Frontiers (NSF), Sept. 1996; Wm. Brewster Medal, Amer. Ornithologists' Union, 1996; Award for Excellence in Research, Univ. at Albany, 1997.

EMPLOYMENT:

Professor Emeritus of Biology, University at Albany, 2003-.
Professor of Biology, University at Albany, 1984-2003.
Adjunct Professor, University of Mississippi, 1996-2001.
Associate Professor of Biology, Univ. at Albany, 1977-84 (tenured).
Director, Cranberry Lake Biol. Station, SUNY, 1973.
Assistant Professor of Biology, Univ. at Albany, 1971-1977.
Fellowship, Institute of Ecology, University of Georgia, 1971.
Research Assistant, University of Georgia, 1969-1970.
Museum field expedition to Peru, Louisiana St. Univ., summer, 1968.
Teaching Assistant, Louisiana State Univ., 1968-1969.
Teaching Assistant, University of Louisville, 1966-1968.

RESEARCH INTERESTS:

Animal migration and orientation, esp. of birds; behavioral ecology

TEACHING INTERESTS:

Animal Behavior, Behavioral Ecology, Ecology, Ornithology, Evolution

UNIVERSITY SERVICE:

College Council, 1982-84; Library Council, 1983-85; President's Budget Panel, 1985; College Comm. Academic Standing, 1984-87; Inst. Animal Care & Use Comm., 1986-2001, Chair, 1995-1998, 1999-2001; College Comm. on Promotion and Continuing Appointment, 1987-89; Graduate Academic Council, 1989-90; Science Research Advisory Comm.; Biology Dept. representative to Univ. in High School program; Mentoring undergraduate students, 1995-96; College of Arts and Sciences Comm. on Promotion and Continuing Appt, 1996-97, 1997-98, 2000-2001; Search Comm. for Dean, College of Arts and Sciences, 1997-98; Search Comm. for Research Compliance Officer, 1999-2000.

PROFESSIONAL SOCIETIES AND SERVICE:

Amer. Ornithologists' Union (Fellow, 1981; Treasurer, 1981-85; Council member 1999-2002); Amer. Soc. of Naturalists (elected, 1974); Animal Behavior Soc. (fellow, 1992); Cooper Ornithological Soc.; International Soc. for Behavioral Ecology; Wilson Ornithological Soc.

Host chairman, Northeast Regional Anim. Behav. Meeting, SUNYA, Nov. 1985.
Member, N.S.F. national committee on use of wild birds in research.
Member, Birdlife Advisory Comm., N.Y.S. Park Commission.
Member, Steering Committee, Rienow Center for the Environment.
Director, Amer. Birding Assoc., 1986-95, 1999-.
Organizer of symposium, N.Y.S. Museum Natural History Conference, April, 1992.
Member, Advisory Board, N.S.F. Public Participation in Ornithology (National Science Experiment), Cornell Laboratory of Ornithology, 1992-94.
Member, New York State Avian Records Committee.
Editor, Monographs in Field Ornithology, Amer. Bird. Assoc. , 1989-.
Advisory panel on endangered species listing, NYS Department of Environmental Conservation, 1993.
Advisory committee for NY Heritage Program-Nature Conservancy study of bird migration along the Lake Ontario shoreline, 1993-94.
Member, Steering Comm., Animal Navigation Group, Royal Inst. of Navigation, London, 1993-.
Member, Section on Fish & Wildlife Resources and Section on Ecology, Nat. Assoc. of State Universities and Land-grant Colleges, 1994-.
Member, Section on Ecology, Nat. Assoc. of State Universities and Land-grant colleges, 1999-.
Member, Migratory Bird Advisory Comm., proposed Conte National Wildlife Refuge, 1994.
Editorial Board, Bird Behavior, 1995-.
Member, A.O.U. comm. on use of wild birds in research, 1995.
Advisory Committee, NY Important Bird Areas project, Nat. Audubon Society, 1996-.
Science Advisor, Earth & Sky program, National Public Radio, 1996-.
Organizer, Winter Animal Behavior Conference XIX, 1997.
Editorial board, North American Birds, 2000-.
Consulting Editor, Cornell University Press, 2000-.

Member, National Technical Committee, Important Bird Areas Program, Nat. Audubon Society, 2001-.

REVIEWER:

Manuscripts: Amer. Birds; Amer. Naturalist; Animal Behaviour; Auk; Avian Biol.; Behav. and Brain Sciences; Behav. Ecol. Sociobiol.; Biol. Bull.; Condor; Current Ornithology; Ecology, Ethology, Evolution; Ethology; J. Comp. Physiol.; J. Comp. Psychol.; J. Exper. Biol.; J. Field Ornithol.; Magnetite Biomineralization and Magnetoreception in Organisms; Nature; Ornithol. Monogr.; Perception; Proc. Nat. Acad. Sci. USA; Proc. Royal Soc. Lond.; Q. Rev. Biol.; Science; Scientific Amer. Books; Trends in Ecology & Evolution; Wilson Bull.

Grant Proposals: NSF, NIH, F.M. Chapman Mem. Fund, Nat. Geog. Soc., Smithsonian Inst., Whitehall Foundation, NSERC (Canada), Israeli Science Foundation.

Textbook Manuscripts: Animal Behavior; The Biology of Animal Behavior; Perspectives on Animal Behavior; Biology.

Outside Reader, Theses: A. McLean, Ph.D., Univ. Rochester, 1980; U. Munro, Ph.D., Univ. of New England, Australia, 1992; C. Simms, Ph.D., Univ. of Mississippi, 1996-.

Consultant: Encyclopedia of North American Birds, Knopf.

GRANT SUPPORT:

Research Fndn. of SUNY Grant-in-Aid: 1972 - $3,200; 1973 - $2,700.

N.S.F.: Field Studies of the Orientation of Free-flying Bird Migrants, 1974-76, $35,000.

Field Studies of Migratory Orientation, 1976-78, $50,000.

Field-experimental Studies of Avian Migratory Orientation and Navigation, 1980-83, $105,000.

Travel grant to attend XVIII Intern. Ornithol. Congress, Moscow, 1982.

Experimental Analysis of the Avian Migratory Orientation and Navigation System, 1983-86, $75,000.

Ontogeny of Orientation Mechanisms in Birds, 1986-89, $181,000.

Development of Migratory Orientation, 1989-90, $30,000.

Interactions and Flexibility in the Orientation System of Migratory Birds, 1992-95, $255,000.

The Orientation of a Night-migrating Songbird, 1995-98, $186,000.

National Research Council: travel grant to attend XVII Intern. Ornithol. Congress, West Berlin, 1978.

NYS/UUP: Experienced Faculty Travel Award to attend XX Intern. Ornithol. Congress, Christchurch, N.Z., 1990.

INVITED LECTURES:

Plenary Lecture: North American Ornithological Conference, Sept., 2002, New Orleans
Keynote speaker: Mass. Audubon Society 5th Annual Birders' Mtg., 1993
Vermont Bird Conference, 1995
New York State Federation of Bird Clubs, 1996
Kentucky Ornithological Society, 2001
Cornell Univ., 1971, 1982, 1984, 1999
SUNY at Potsdam, 1973
Utica College, 1974, 1996
Kansas State University, 1974
Bennington College, 1974
University of Rhode Island, 1974
Princeton University, 1975, 1998
Colgate University, 1975
SUNY at Stony Brook, 1977
SUNY at Binghamton, 1978
Siena College, 1978, 1990, 1997
Skidmore College, 1978, 1984, 1991
Pennsylvania State University, 1979
Rockefeller University, 1979, 1996
Linnaean Society of New York, 1979, 1994
Middlebury College, 1979
N.Y.S. Museum, 1979, 1980, 1983
Williams College, 1980
SUNY at Geneseo, 1981
University of Illinois, 1981
University of Maine, 1984, 2001
Bowdoin College, 1984
NASA Langley Research Laboratory, 1984
Vassar College, 1985
University of Massachusetts, 1988
Union College, 1990
Ithaca College, 1992
St. Lawrence University, 1992
Ithaca College, 1992
University of North Carolina, 1994
Clemson University, 1994
University of Vermont, 1995
Dartmouth College, 1998

Swarthmore College, 1999
University of California, Davis, 2000
University of Nevada, Reno, 2000

INVITED SYMPOSIA:

1971. Symposium on Bird Migration in the Region of the Gulf of Mexico, Dauphin Island, Alabama.
1974. Conference on the Biological Aspects of the Bird/Aircraft Collision Problem, Clemson University.
1977. Animal Orientation and Navigation, Tubingen, West Germany (K. Schmidt-Koenig and W.T. Keeton, chairmen).
1978. International Ornithological Congress, West Berlin (S.T. Emlen and W. Wiltschko, convenors).
1980. Mini-symposium on Bird Migration, Orientation and Homing, Rockefeller University, Millbrook, New York.
1981. International Symposium on Avian Navigation, Tirrenia, Italy (F. Papi and H.G. Wallraff, Chairmen).
1982. XVIII International Ornithological Congress, Moscow, USSR (W. Wiltschko and I. Vilks, convenors).
1983. Migration: Mechanisms and Adaptive Significance. Centennial Symposium, University of Texas.
1986. XVIX International Ornithological Congress, Ottawa, (W. Wiltschko and K.P. Able, convenors).
1987. Winter Animal Behavior Conference IX, Park City, Utah.
1987. XX International Ethology Congress, Madison, Wisconsin.
1988. Winter Animal Behavior Conference X, Park City, Utah.
1988. Recent Developments in the Study of Animal Migration, Amer. Soc. of Zoologists, San Francisco.
1990. XX International Ornithological Congress, Christchurch, N.Z.
1993. Winter Animal Behavior Conference XV, Jackson Hole, WY.
1993. Symposium, Soc. for Experimental Biology, Canterbury, Kent, England.
1993. Orientation and Navigation. Birds, Humans and Other Animals. Royal Inst. of Navigation, Oxford, England.
1994. Winter Animal Behavior Conference XVI, Jackson Hole, WY.
1994. XXI International Ornithological Congress, Vienna, Austria (K.P. Able and K. Schmidt-Koenig, conveners).
1995. Animal Navigation Symposium, Company of Biologists, Cambridge, England.
1997. Winter Animal Behavior Conference XIX, Jackson Hole, WY.
1997. Orientation and Navigation. Birds, Humans and Other Animals. Royal Inst. of Navigation, Oxford, England.
1998. XXII International Ornithological Congress, Durban, South Africa (Symposium convener and speaker).
2001. Symposium on Avian Migration, Radolfzell, Germany.

PUBLICATIONS:

<u>Papers:</u>

Able, K.P. 1962. The cyclic occurrence of some winter birds in the B.O.S. study area.

Prothonotary, 28:18-23, 127- 131.
Able, K.P. 1962. A note on the migration of the parasitic jaeger in the B.O.S. study area. Prothonotary, 28:110-111.
Able, K.P. 1963. Television tower mortality in the Niagara Frontier during fall, 1962. Kingbird, 13:192-195.
Able, K.P. 1965. Summer birds of Shelby County. Indiana Audubon Quart., 43:96-111.
Able, K.P. 1966. Television tower mortality near Louisville. Kentucky Warbler, 42:27-28.
Able, K.P. 1968. Some aspects of the ecology of Henslow's sparrow in Kentucky. M.S. thesis, Univ. of Louisville.
Monroe, B.L., Jr., and K.P. Able. 1968. Recent additions to the avifauna of Kentucky. Kentucky Warbler, 49:55-57.
Able, K.P. 1970. A radar study of the altitude of nocturnal passerine migration. Bird-Banding, 41:282-290.
Gauthreaux, S.A., Jr., and K.P. Able. 1970. Wind and the direction of nocturnal songbird migration. Nature, 228:476-477.
Gauthreaux, S.A., Jr., and K.P. Able. 1971. Nocturnal songbird migration. Nature, 230:580.
Able, K.P. 1971. Environmental influences on the nocturnal migration and orientation of birds. Ph.D. dissertation, Univ. of Georgia.
Able, K.P. 1972. Fall migration in coastal Louisiana and the evolution of migration patterns in the Gulf region. Wilson Bull., 84:231-242.
Able, K.P. 1973. The role of weather variables and flight direction in determining the magnitude of nocturnal bird migration. Ecology, 54:1031-1041.
Able, K.P. 1974. Environmental influences on the orientation of nocturnal bird migrants. Anim. Behav., 22:225-239.
Able, K.P. 1974. Wind, track, heading and the flight orientation of migrating songbirds. Proc. Conf. on Biol. Aspects of the Bird/Aircraft Collision Problem, pp. 331-357.
Able, K.P., and S.A. Gauthreaux, Jr. 1975. Quantification of nocturnal migration with a portable ceilometer. Condor, 77:92-96.
Able, K.P., and B.R. Noon. 1976. The structure of avian communities along elevational gradients in the northeastern United States. Oecologia, 26:275-294.
Able, K.P. 1977. The orientation of songbird migrants following displacement by the wind. Auk, 94:320-330.
Able, K.P., and P.M. Dillon. 1977. Sun compass orientation in a nocturnal migrant, the white-throated sparrow. Condor, 79:393-395.
Able, K.P. 1978. Field studies of the orientation cue hierarchy of nocturnal songbird migrants. In K. Schmidt-Koenig and W.T. Keeton, eds., Animal Migration, Navigation and Homing, pp. 228-238. Springer-Verlag, Berlin.
Noon, B.R., and K.P. Able. 1978. A comparison of avian community structure in the northern and southern Appalachian Mountains. Forest Serv. Gen. Tech. Rep. SE-14, pp. 98-117. U.S. Dept. Agriculture.
Bingman, V.P., and K.P. Able. 1979. The sun as a cue in the orientation of the white-throated sparrow, a nocturnal migrant. Anim. Behav., 27:621-622.
Able, K.P. 1980. Mechanisms of orientation, navigation, and homing. In S.A. Gauthreaux, Jr., ed., Animal Migration, Orientation and Navigation, pp. 283-373.

Academic Press, N.Y.
Able, K.P. 1980. Migratory behavior. McGraw-Hill Encyclopedia of Science and Technology.
Able, K.P. 1980. Evidence on migratory orientation from radar and visual observations: North America. Proc. XVII Intern. Ornithol. Congr., pp. 540-546.
Gould, J.L., and K.P. Able. 1981. Human homing: An elusive phenomenon. Science, 212:1061-1063.
Bingman, V.P., K.P. Able, and P. Kerlinger. 1982. Wind drift, compensation, and the use of landmarks by nocturnal bird migrants. Anim. Behav., 30:49-53.
Able, K.P. 1982. Field studies of bird migration--a brief overview and some unanswered questions. Cont. Birdlife, 2:101-110.
Able, K.P. 1982. Field studies of avian nocturnal migratory orientation. I. Interaction of sun, wind and stars as directional cues. Anim. Behav., 30:761-767.
Able, K.P., V.P. Bingman, P. Kerlinger, and W.F. Gergits. 1982. Field studies of avian nocturnal migratory orientation. II. Experimental manipulation of orientation in white-throated sparrows released aloft. Anim. Behav., 30:768-773.
Able, K.P. 1982. The effects of overcast skies on the orientation of free-flying nocturnal migrants. In F. Papi and H.G.Wallraff, eds., Avian Navigation, pp. 38-49. Springer-Verlag, Berlin.
Able, K.P. 1982. Skylight polarization patterns at dusk influence the migratory orientation of birds. Nature, 299:550-551.
Able, K.P. 1982. Ivory gull visits a bird feeder in Saratoga Springs. Kingbird, 32:75-77.
Able, K.P., S.B. Terrill, and J.D. Cherry. 1982. Not by mirrors. Nature, 298:510.
Able, K.P. 1983. Commentary--Bird Navigation. In A.H. Brush and G.C. Clark, eds., Perspectives in Ornithology, pp. 542-548. Cambridge Univ. Press.
Able, K.P., W.F. Gergits, J.D. Cherry, and S.B. Terrill. 1984. Homing behavior of wood thrushes (Hylocichla mustelina): a radio tracking study. Behav. Ecol. Sociobiol., 15:39-43.
Able, K.P., and J.D. Cherry. 1985. Laboratory and field studies of avian migratory orientation. In M.A. Rankin, ed., Migration: Mechanisms and Adaptive Significance, pp. 516-525. Contrib. Marine Sci. Suppl., vol. 27. Marine Science Institute, Univ. of Texas.
Able, K.P., and W.F. Gergits. 1985. Human navigation: Attempts to replicate Baker's displacement experiment. In D.S. Jones, B.J. MacFadden, and J.L. Kirschvink, eds., Magnetite Biomineralization and Magnetoreception in Organisms, pp. 569-572. Plenum, New York.
Kerlinger, P., V.P. Bingman, and K.P. Able. 1985. Comparative flight behavior of migrating hawks studies with tracking radar during autumn in central New York. Can. J. Zool., 63:755-761.
Able, K.P. 1985. Radar methods for the study of hawk migration. In M. Harwood, ed., Proc. IV Hawk Migration Conf., pp. 347-354.
Able, K.P. 1985. The contribution of radar and visual techniques to orientation research. Acta XVIII Congr. Intern. Ornithol. (V.D. Ilyichev and V.M. Gavrilov, eds.), pp. 293-299. Nauka, Moscow.
Cherry, J.D., and K.P. Able. 1986. An alternative method for the analysis of Emlen funnel data. Auk, 103:225-227.

Able, K.P., and J.D. Cherry. 1986. Mechanisms of dusk orientation in white-throated sparrows (Zonotrichia albicollis): Clock-shift experiments. J. comp. Physiol., 159:107-114.
Able, K.P., and S.B. Terrill. 1986. A release cage for the study of migratory orientation: Technique and preliminary results. Auk, 104:135-139.
Able, K.P., and V.P. Bingman. 1987. The development of orientation and navigation behavior in birds. Q. Rev. Biol., 62:1-29.
Able, K.P. 1987. Geomagnetic disturbance and migratory bird orientation: Is there an effect? Anim. Behav., 35:599-601.
Able, K.P., and V.P. Bingman. 1988. The development of migratory orientation. Acta XIX Intern. Ornithol. Congr., pp. 1932-1940, Univ. Ottawa Press.
Terrill, S.B., and K.P. Able. 1988. Bird migration terminology. Auk, 105:205-206.
Holberton, R.L., K.P. Able and J.C. Wingfield. 1989. Status signalling in dark-eyed juncos, Junco hyemalis: experimental manipulations and hormonal correlates of dominance. Anim.Behav., 37:681-689.
Able, K.P. 1989. Skylight polarization patterns and the orientation of migratory birds. J. exp. Biol., 141:241-256.
Able, K.P., and M.A. Able. 1990. Ontogeny of migratory orientation in the Savannah sparrow, Passerculus sandwichensis: mechanisms at sunset. Anim. Behav., 39:1189-1198.
Able, K.P., and M.A. Able. 1990. Ontogeny of migratory orientation in the Savannah sparrow, Passerculus sandwichensis: calibration of the magnetic compass. Anim. Behav., 39:905-913.
Able, K.P. 1990. Experimental studies of the development of migratory orientation mechanisms. Experientia, 46:388-394.
Holberton, R.L., R. Hanano and K.P. Able. 1990. Age-related dominance in dark-eyed juncos: effects of plumage and prior residence. Anim. Behav., 40:573-579.
Able, K.P. 1990. Comparison of vanishing bearings, orientation directions and ringing recoveries of spring migrant white-throated sparrows (Zonotrichia albicollis). J. f. Ornithol., 131:317-323.
Able, K.P. and M.A. Able. 1990. Calibration of the magnetic compass of a migratory bird by celestial rotation. Nature, 347:378-380.
Able, K.P. 1991. Common themes and variations in animal orientation systems. Amer. Zool., 31:157-167.
Able, K.P. 1991. The development of migratory orientation mechanisms. In P. Berthold, ed., Orientation in Birds, pp. 166-179.
Able, K.P. 1991. Maps, compasses and birds. In J. Grier and T. Burk, The Biology of Animal Behavior, pp. 242-243. Times Mirror/Mosby.
Holberton, R.L. and K.P. Able. 1992. Circannual cycle of a migratory bird persists in constant dim light. J. comp. Physiol., A, 171:477-481.
Able, K.P. 1992. Migratory behavior. Pp. 196-198, McGraw-Hill Encyclopedia of Science and Technology.
Able, K.P. and M.A. Able. 1993. Magnetic orientation in the Savannah sparrow. Ethology, 93:337-343.
Able, K.P. and M.A. Able. 1993. Interactions and flexibility in the orientation system of migratory birds. In Orientation and Navigation. Birds, Humans and Other

Animals. Royal Inst. Nav., London, Paper no. 9.
Able, K.P. and M.A. Able. 1993. Daytime calibration of magnetic orientation in a migratory bird requires a view of skylight polarization. Nature, 364:523-525.
Able, K.P. and M.A. Able. 1993. Interactions and flexibility in the orientation system of migratory birds. J. Navigation, 46:353-358.
Able, K.P. 1993. Orientation cues used by migratory birds: A review of cue-conflict experiments. Trends in Ecology and Evolution, 8:367-371.
Able, K.P. 1994. Magnetic orientation and magnetoreception in birds. Progress in Neurobiology, 42;449-473.
Able, K.P. 1995. Orientation and navigation: A perspective on fifty years of research. Condor, 97:592-604.
Able, K.P. and M.A. Able. 1995. Manipulations of polarized skylight calibrate magnetic orientation in a migratory bird. J. comp. Physiol., A, 176:351-356.
Able, K.P. and M.A. Able. 1995. Interactions in the flexible orientation system of a migratory bird. Nature, 375:230-232.
Able, K.P. and M.A. Able. 1996. The flexible migratory orientation system of the Savannah sparrow (Passerculus sandwichensis). J. exper. Biol., 199:3-8.
Able, K.P. 1996. Large-scale navigation. J. exper. Biol., 199:1-2.
Able, K.P. 1996. The debate over olfactory navigation by homing pigeons. J. exper. Biol., 199:121-124.
Able, K.P. 1996. In memoriam: Burt L. Monroe, Jr., 1930-1994. Auk, 113:924-927.
Able, K.P. and M.A. Able. 1996. Migratory orientation: autumn calibration of magnetic orientation is not evident in spring. Naturwissenschaften, 83:517-518.
Gaunt, A.S., L.W. Oring, K.P. Able, D.W. Anderson, L. Baptista, J.C. Barlow, and J.C. Wingfield. 1997. Guidelines for the use of wild birds in research. Ornithol. Council, Washington, D.C., vii + 52 pp.
Able, K.P. and M.A. Able. 1997. Development of sunset orientation in a migratory bird: no calibration by the magnetic field. Anim. Behav., 53:363-368.
Able, K.P. and M.A. Able. 1997. The orientation system of migratory birds: innate information, learning rules and adaptive plasticity. In Orientation and Navigation - Birds, Humans and Other Animals. Royal Inst. of Navigation, London.
Able, K.P. and M.A. Able. 1998. The roles of innate information, learning rules and plasticity in migratory bird orientation. J. Navigation, 51:1-9.
Able, K.P. and J.R. Belthoff. 1998. Rapid Aevolution@ of migratory behaviour in the introduced house finch (*Carpodacus mexicanus*) of eastern North America. Proc. Royal Soc. Lond. B, 265:2063-2071.
Able, K.P. and M.A. Able. 1999. Migratory orientation: learning rules for a complex behaviour. In: Adams, N.J. and R.H. Slotow (eds.), Proc. 22nd Int. Ornithol. Congress, Durban, pp. 2356-2365. Johannesburg: Birdlife South Africa.
Able, K.P. and M.A. Able. 1999. Evidence for calibration of magnetic orientation in Savannah sparrows reared in the field. Proc. Royal Soc. Lond. B, 266:1477-1481.
Bingman, V.P., K.P. Able, and J.J. Siegel. 1999. Hippocampal lesions do not impair the geomagnetic orientation of migratory Savannah sparrows. J. comp. Physiol. A, 185:577-581.
Holberton, R.L. and K.P. Able. 2000. Differential migration and an endocrine response

to stress in wintering dark-eyed juncos (Junco hyemalis). Proc. Royal Soc. Lond. B, 267:1889-1896.

Able, K.P. 2001. The concepts and terminology of bird navigation. J. Avian Biol., 32:174-183.

Able, K.P. 2002. Homing and migration. The New Book of Knowledge, Grolier Educational Publ., pp. 195-200.

Able, K.P. 2002. Avian migration and navigation. Grzimek=s Animal Life Encyclopedia, Gale Grp., pp.

Schneider, K.J. and K.P. Able. 2002. An analysis of breeding birds of the Hudson River Valley and their suitability for natural resource injury studies. Report submitted to the Hudson River Natural Resources Trustee Council.

Bingman, V.P. and K.P. Able. 2003. Maps in birds: Representational mechanisms and neural bases. Curr. Opinion Neurobiology, in prep.

Holberton, R.L. and K.P. Able. 2005. In memoriam: Eberhard Gwinner. Auk, 122:1013-1015.

Books and Text Chapters:

Able, K.P. 1998. Eight species accounts in Bull=s Birds of New York State. Cornell Univ. Press.

Able, K.P. 1999. (Editor and author of three chapters) Gatherings of Angels: Migrating Birds and Their Ecology. Cornell Univ. Press, xiv + 194 pp.

Able, K.P. 2004. Chapter 5, Birds on the Move: Flight and Migration. *In* Handbook of Bird Biology (S. Podulka, R. Rohrbaugh, Jr., and R. Bonney, eds.). Cornell Lab of Ornithology, Ithaca, New York.

Able, K.P. Mechanisms of Bird Navigation. In preparation for Monographs in Behavior and Ecology series published by Princeton Univ. Press (contract signed Aug., 1999)

Abstracts:

Able, K.P. 1970. Nocturnal bird migrants: Two methods of flight orientation? Bull. Ecol. Soc. Amer., 51:43.

Able, K.P. 1973. Tracking radar studies of migratory orientation in birds. Amer. Zool., 13:1263.

Able, K.P. 1975. Avian community structure along elevational gradients in the northwestern United States. Bull. Ecol. Soc. Amer., 56:21.

Able, K.P. and M.A. Able. 1994. The development of migratory orientation mechanisms. J. f. Ornithol., 135:372.

Able, K.P. and W. Wiltschko. 1998. Summary: Adaptive plasticity in migratory orientation mechanisms. Ostrich, 69:54.

Able, K.P. and M.A. Able. 1998. Migratory orientation: Learning rules for a complex behaviour. Ostrich, 69:123.

Reviews and Semipopular Articles:

Able, K.P. 1972. The changing seasons. The fall migration, 1971. Amer. Birds, 26:25-30.
Able, K.P. 1973, 1974. The changing seasons. Amer. Birds, 27:19-23; 28:22-27.
Able, K.P. 1974. Review: The Visible Migration of Birds at Ottenby, Sweden. C. Edelstam, ed. Bird-Banding, 45:290- 291.
Able, K.P. 1975. Review: Visible Bird Migration at Falsterbo, Sweden. S. Ulfstrand, G. Roos, T. Alerstam, and L. Osterdahl, eds. Bird-Banding, 46:97.
Able, K.P. 1975. Review: Autumn Hawk Flights. D.S. Heintzelman. Bird-Banding, 47:89-91.
Able, K.P. 1976. Review: Birds of New York State. J. Bull. Bird-Banding, 47:89-91.
Able, K.P. 1979. Review: The Evolutionary Ecology of Animal Migration. R.R. Baker. Amer. Sci., 67:355-356.
Able, K.P. 1979. Review: Bird Flight. G. Ruppell. Bios, 50:99-100.
Able, K.P. 1980. The changing seasons. Amer. Birds, 34:249-252.
Able, K.P. 1981. Review: The Mystery of Migration. R.R. Baker. Q Rev. Biol., 59:59.
Able, K.P. 1982. Review: Animal Migration. R.D. Aidley, ed. Q. Rev. Biol., 57:340-341.
Able, K.P. 1983. Trends in the state list of New York birds. Kingbird, 33:6-12.
Able, K.P. 1983. The limits of technology. Point Reyes Bird Observ. Newsletter 61.
Able, K.P. 1983. A migratory bird's baedeker. Natural History, 92:22-27.
Able, K.P. 1983. Chips from the night sky. Living Bird Quart., 2:10-13.
Able, K.P. 1984. Review: Weather and Bird Behaviour. N. Elkins. Wilson Bull., 96:367-368.
Able, K.P. 1984. Review: Animals as Navigators. E.W. Anderson. Q. Rev. Biol., 59:360-361.
Able, K.P. 1986. Migration and navigation. Chapter in The Birds Around Us. Ortho Information Services.
Able, K.P. 1989. Review: Animal Navigation. T.H. Waterman. Q. Rev. Biol., 64:527-528.
Able, K.P. 1991. Migration biology for birders. Birding, 23:64-72.
Terrill, S.B., K.P. Able and M.A. Patten. 1992. The changing seasons. Summer, 1992. Amer. Birds, 46:1109-1111, 1182.
Able, K.P. 1993. Searching for the phantom of New Zealand. Birding, 25:178-183.
Able, K.P. 1994. Review: Animal Homing. F. Papi, ed. Anim. Behav., 48:489-490.
Able, K.P. 1994. Review: Bird Migration. T. Alerstam. Condor, 96:246.
Able, K.P. 1995. Review: Bird Migration, Weather and Fallout. R.A. Duncan. Birding, 27:237-238.
Able, K.P. 1996. Review: Migration. The Biology of Life on the Move. H. Dingle. Anim. Behav., 53:437-438.
Able, K.P. 1996. Review: Magnetic Orientation in Animals. R. Wiltschko and W. Wiltschko. J. Navigation, 49:453-454.
Able, K.P. 1996. [Author of Introduction and one chapter, Birding New York=s Hudson-Mohawk Region, Hudson-Mohawk Bird Club.]
Able, K.P. 1997. Review: Control of Bird Migration. P. Berthold. Auk, 114:534-535.
Able, K.P. 1998. A sense of magnetism. Birding, 30:314-321.
Able, K.P. 2000. Review: Handbook of the Birds of the World, Vol. 5. J. Del Hoyo, A. Elliott and J. Sargatal. Auk, 117:532-534.
Able, K.P. 2000. Sage grouse futures. Birding, 32:306-316.

Able, K.P. 2002. Review: Bird Migration. A General Survey. P. Berthold. Auk, in press.

Able, K.P. 2007. Review: Ivorybill Hunters: The Search for Proof in a Flooded Wilderness. G.E. Hill. Birding, 39:82-88.