

JSPS Final Report - September 1999

Title of Research: An Investigation of Intraspecific Behavior in Bottlenose Dolphins around Mikura Island.

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A) OUTLINE OF SCIENTIFIC ACTIVITIES WHILE IN JAPAN

From 15 September 1997 to 1 August 1999, data were gathered from 82 four-hour trips to observe the Mikura dolphins to address objectives listed in my JSPS proposal. I established connections with dolphin guides, boat captains, and the Nature Center on Miyake, and routinely joined several of these groups to observe and record the behavior and vocalizations of the dolphins around Mikura Island (located about 180 km south of Tokyo). Details from boat trips are summarized per month in Table 1. Preliminary analyses provide early patterns in the data and are presented according to each appropriate objective. Sound digitizing and analysis will continue into autumn 1999 for data gathered from June and July, 1999. A list of manuscripts in preparation from this dataset is included below.

1) SUMMARY OF RESEARCH EFFORT

Table 1 presents effort expended to gather videotaped data on dolphin behavior and signal exchange. Also, time was spent each month analyzing videotapes, writing reports (and conference presentations), identifying individual dolphins from videotapes, and studying Japanese to be able to communicate with the residents of Miyake - especially boat captains and dolphin guides. Field trips were conducted, and thus data collected, whenever space was available on dolphin swim trips to Mikura for tourists. These trips decrease in number between 30 September and 1 May each year because of increasingly inclement weather and sea conditions with a corresponding decrease in the number of tourists to Miyake. During these months, attention was focused on data analysis and manuscript or conference presentation preparation.

Table 1. Effort expended by month gathering data on dolphin behavior and vocalizations around Mikura Island, Japan. Number (#) of minutes of effort represents duration spent within 200 m of Mikura's coastline. # min. of video represents total number of video minutes recorded with dolphins in view. # dolphins sighted includes all dolphins observed, including potential re-sights during one trip. No boat trips were conducted in Dec ('97 & '98), Feb ('98 & '99), June ('98), or Jan. ('99), thus these months are not included in the Table.

Month	# Boat trips	# Min. Effort	# Min. Video	# dolphins sighted
Sept. ('97)	6	577	15.8	134
Oct. ('97)	14	1686	46.1	488
Nov. ('97)	1	111	0.42	12
Jan. ('98)	2	319	6.8	62
Mar. ('98)	1	129	1.7	50
Apr. ('98)	4	491	38.0	70

Table 1. continued

Month	# Boat trips	# Min. Effort	# Min. Video	# dolphins sighted
May ('98)	8	1516	63.2	260
July ('98)	10	1183	50.5	235
Aug. ('98)	10	1063	30.6	268
Sep. ('98)	4	478	33.6	104
Oct. ('98)	1	133	9.9	35
Nov. ('98)	1	110	10.6	30
Mar. ('99)	2	153	0	40

Apr. ('99)	2	226	1.9	35
May ('99)	4	439	16.8	80
June ('99)	7	732	26.4	206
July ('99).	5	557	40.9	110
TOTALS:	82	9903*	393.2**	2219***

*~165 hrs of effort, ** ~6.6 hrs of video, *** population size is much lower (see above).

2) PRELIMINARY ANALYSES SUGGEST

Listed are the objectives as presented in my original proposal to JSPS. I discuss my research and data collected during the tenure of my JSPS fellowship in relation to each objective. Overlap of data is indicated between objectives by listing discussions jointly.

- a) Observation data following focal animal and all-occurrence sampling protocols will be collected to determine how the shallow, near-shore inlets around Mikura Island are used by dolphins.
- b) Video and still photography will be used to document the exchange of contact and vocal behaviors among individual dolphins to determine how these behaviors are related to dolphin identification, age, gender, and group behavioral activity.

Dolphin behavior and vocalizations were documented in 393.2 minutes of video. A merger of my data with information from I.C.E.R.C. Japan suggests that a minimum of 126 individually identifiable dolphins frequent Mikura's coast (Calves less than one year in age do not always possess scars or other marks for reliable re-identification between years.) As of August 1999, the estimated age and sex distribution in this dolphin study group is:

	Female	Male	Unidentified	TOTAL
Adult	30	19	0	49
Sub-adult	4	36	0	40
Juvenile	12	12	7	31
Calf	2	2	2	6
TOTAL	48	69	9	126

(Note that data are based upon Dudzinski's additions during 1997 – 1999 to I.C.E.R.C. Japan's dolphin identifications from 1994 – 1998)

Five dolphins shifted from sub-adult to the adult age class during this two-year study period. The most frequently observed age class increase was from calf to juvenile; however, the exact sample size remains undetermined because not all calves less than one year in age could be reliably re-identified between seasons. The number of calves observed was with respect to adult females observed with a new calf per year.

A seasonal trend in the use of the waters at Mikura by different age groups was evident. Adult females with calves are present in dominant numbers from late April to early July. This trend may continue into September although that data has yet to be analyzed. While dolphins were observed around Mikura in winter months, individuals present were usually subadult males or adult dolphins of both genders. Subadult males and older juveniles were observed during spring and summer months and were often recorded as playing or socializing. The latter activity was either in mixed sex groups or with all male groups. Thus, distribution differences based upon dolphin gender around Mikura seem attributable to the presence or absence of mother/calf pairs on a seasonal basis. Water temperature declines significantly in winter months while sea surface height increases. These factors may lead adult females with calves and younger dolphins to seek warmer, calmer waters from roughly November to late April each year. More data on dolphin distribution in areas other than Mikura are required to address this hypothesis.

Analyses are ongoing of dolphin identifications and distributions around Mikura from my data and from that of I.C.E.R.C. Japan. These analyses will address the question of site fidelity around Mikura by specific individual dolphins and groups of dolphins. Similarly, association coefficients will be examined to determine if members of this study group have preferred partners as has been observed for other

bottlenose dolphin groups (e.g., in Sarasota Bay, FL (Wells et al. 1987, Shark Bay, Australia (Conner et al. 1990). Preliminary analyses suggest preferred partners do exist in the Mikura study group.

- c) Data on tactile and vocal behaviors gathered and analyzed from both dolphin study-groups --Mikura bottlenose and Bahamas Atlantic spotted-- will be compared to determine the extent of similarity and differences.
- d) Sighting and environmental data will be compared with recorded behaviors from both dolphin study groups to determine if these external factors have a significant effect on dolphin behavior.

Bottlenose dolphins around Mikura Island coordinate their use of vocalizations and behaviors according to context and group type while interacting with conspecifics. A focal follow protocol was used to examine dolphin vocalizations and behavior from video data gathered from Sept 1997 – July 1999. Pulsed vocalizations were examined qualitatively with quantitative analyses ongoing. Clicks and click trains were recorded mostly in two contexts – inquisitive and forage. Inquisitive behaviors included fast or slow swim approaches with head-scan movements directed at a target (swimmers or conspecifics) or circle swimming around a target with head-scan movements. Behaviors documented during forage activity included chasing and ingesting flying fish and rooting into boulder crevices while vertical, head down. Pops, squawks and other pulsed vocalizations were recorded from sub-adult and adult males during social activity only and from juveniles (gender undetermined) or adult females during play.

Use of frequency-modulated tones (FMs, whistles) and behaviors according to context and group type while interacting with conspecifics are also coordinated. From all ages and both genders, roughly 2,900 FMs were recorded during all activities though predominantly during social (n=922) and inquisitive (1456) contexts. (Note - data from June and July 1999 are not included in the following calculations since data analyses are ongoing and as yet incomplete for the current field season (Table 2).) Adult females with juveniles (AFjuv, n=1416) and mixed gender, age (mixed, n=1125) groups were significantly more vocal compared with other groups (n=356). For 949 whistles (32.8% of all FMs), identity of the vocalizing dolphin was confirmed. For 1676 and 2038 FMs, gender and age, respectively, were determined. Previously, it has been suggested that bottlenose dolphins produce bubble streams (BBS) often and concurrent with whistling; however, slightly more whistles without BBS were recorded (without BBS, n=1301, with BBS, n=1164). BBS accompanied significantly more whistles from females ($\chi^2=86.76$, $df=1$, $p<0.0001$), while male dolphins produced twice as many FMs without BBS.

A seasonal distribution in whistling was documented that may explain the difference in female/male FM production: sub-adult and adult males were seen predominantly in fall and winter and were often silent, while adult females, juveniles, and calves were seen during spring and summer months and were quite vocal. During 141 encounters, AFjuv (n=53) and mixed groups (n=44) were observed around Mikura and were engaged in mostly social (n=42), inquisitive (n=34) and travel/rest (n=37) activities. Adult females produced significantly more whistles with or without BBS in all activities (overall $\chi^2=242.68$, $p<0.0001$; with BBS $\chi^2=126.09$, $p<0.0001$). Mikura Island is bordered by productive oceanic waters and likely represents a protected retreat from hazards of predators and other dangers. Anecdotal evidence, with sighting and vocal data, suggests that foraging and social skills required to live successfully in a fission-fusion society may be taught and learned by dolphins near Mikura.

Table 2. Number of whistles recorded per month of research on dolphin communication at Mikura Island, Japan. If no data were collected (i.e., no boat trips conducted) during a particular month, then that month is not included in the Table. Note that hydrophone error prevented audio recordings during March 1999 through mid-June 1999 (noted as “ae” below).

<u>Month</u>	<u>Number of Whistles</u>	<u>Month</u>	<u>Number of Whistles</u>
Sept. 1997	69	Sept. 1998	833 *
Oct. 1997	259	Oct. 1998	0
Nov. 1997	1	Nov. 1998	0
Jan. 1998	2	Mar. 1999	ae
Mar. 1998	19	Apr. 1999	ae
Apr. 1998	385	May 1999	ae
May 1998	157	June 1999	nd
July 1998	553	July 1999	nd
Aug. 1998	614		

Whistle totals per year:	1997 (329)	1998 (2563)	1999 (nd)
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* whistle number may be over-represented for Sept ('98) due to one particular encounter with several very vocal juvenile dolphins.
 nd = audio tapes not digitized into computer for analysis.

It remains to be confirmed statistically if the dolphins at Mikura use contact behavior and vocalizations during the same type of behavioral activities as do spotted dolphins. It is likely that there is very little difference in the exchange of contact behaviors -- no matter the species. Data analyses are currently ongoing including preparation of a paper that examines the expression and use of contact behaviors and vocalizations between individual bottlenose dolphins at Mikura and compares similarities and differences in behavior expression and use between bottlenose and spotted dolphins. Anecdotal reference to dusky dolphins (*Lagenorhynchus obscurus*) will be included as an outgroup to compare species and geographic influences on behavior expression.

e) Education posters, seminars, and lectures will be planned in collaboration with scientists and field naturalists from Mie University, I.C.E.R.C. Japan, and the Miyake Nature Center to disseminate all results to both scientific and public audiences.

I have attempted to share as much about my research and ongoing analyses as possible with the people who live on Miyake Island, as well as visitors to this island. I have included with this report examples of summaries that I distributed to members of Miyake's resident community. I prepared this "newsletter" quarterly to keep Miyake's residents informed about my progress and my work. Many residents have responded by visiting my office and sharing their observations of dolphin distribution and behavior. Some fishing boat captains have even shared their logs and records of dolphins over several years.

I have participated in eight symposia during my tenure in Japan - seven within Japan and one in the USA. I have assisted local grade school students with a stranded animal on Nijijima. I have given lectures to various school groups that have visited Miyake (from the American School in Japan and a Summer School program run by Jack T. Moyer.), and lectured at the Miyake High School. I have advised two college graduate students - one from Tokyo University and one from Mie University. From February - April 1999, a student from Southampton College, NY, USA, interned with me: I continue to advise this student.

With several colleagues (including scientists, dolphin guides and boat captains), I edited an information booklet that has been distributed to Miyake residents, university students, tourists and academic colleagues world-wide. This booklet includes information on dolphin biology, distribution and behavior as well as a suggested set of manners to follow when swimming or watching dolphins in the wild. I consider it exceptional that co-authors from varied and oft-competitive backgrounds were able to amicably coordinate and cooperate in the preparation of this guide/information booklet.

Amano, M., Barbosa, C., Dudzinski, K.M., Kawaguchi, N., Kikuchi, K., Mori, K., Moyer, J.T., Orams, M.C., Soeda, R., Taguchi, S., Yoshioka, M. 1998. Interactions with dolphins and whales. Japanese Publishers & sponsored by Omega. 57 pp.

During the tenure of my fellowship, I was interviewed by NHK radio about my research (program aired on 20 May 1999). I also agreed to requests from the Girl Scouts of America and Discovery Programs to interviews for young people: interviews that were posted to web pages.

These are examples of my efforts to address this objective and provide educational information simultaneous with gathering data and examining dolphin behavior and communication.

3) COMMENTS ON THE J.S.P.S. FELLOWSHIP PROGRAM

This two-year period, of my J.S.P.S. Post-Doctoral Fellowship, passed much more quickly than I expected. In every phase of my work in Japan, I was supported completely by my Fellowship Host, Dr. Motoi Yoshioka, and the staff of J.S.P.S. I have nothing but praise for all the people who helped make my stay in Japan quite successful and exceptionally productive. My situation has been unique because of

the type of research I conduct and the necessity of extensive amounts of field work throughout each year of my fellowship. On several occasions, Yoshioka-sensei and I had new questions or requests for different strategies for the good people at J.S.P.S. With each request, they assisted us promptly always with positive responses.

My Visa for stay in Japan has been a Cultural Activities Visa, and subsequently, I have made every effort to experience and share in the Japanese Culture. I have been fortunate enough to live on an Island where the residents willingly included and welcomed me into their lives. I will remember J.S.P.S. for their unfailing support of my academic and research goals while in Japan, but I will primarily remember them for providing me the support and opportunity to conduct my research within the scope of a culture very different from one in which I was raised. Not only has my career benefited from this experience, but as a person, I have grown considerably. Thank you.

B) LIST OF CONFERENCE ABSTRACTS, PROCEEDINGS AND PAPERS COMPLETED AND PUBLISHED DURING DUDZINSKI'S JSPS POST DOCTORAL FELLOWSHIP. (Pending publications included.)

PEER-REVIEWED ARTICLES/PROCEEDINGS:

- Dudzinski, K. M., Newborough, D. 1997. Concurrent recording of dolphin behaviors, frequency-modulated tones, and pulsed vocalizations (including echolocation clicks) underwater with a swimmer-propelled system. Proceedings of the Underwater Bio-Sonar Systems and Bioacoustics Symposium, Underwater Acoustics Group, Loughborough, England, 16-17 December 1997.
- Dudzinski, K. M. 1998. Intraspecific contact behavior and signal exchange among free-ranging dolphins - the view from underwater. Proceedings of the 10th Annual International Symposium of the International Marine Biological Research Institute, Kamogawa, Japan, 31 Jan. - 1 Feb. 1998
- Dudzinski, K.M. 1998. Contact behavior and signal exchange among Atlantic spotted dolphins (*Stenella frontalis*). *Aquat. Mamm.* **24**, 129-142.
- Dudzinski, K.M. (submitted). Variation in vocal types produced by Atlantic spotted dolphins (*Stenella frontalis*). *Mar. Mamm. Sci.* to editor on 1 Sep. 1999
- Frohoff, T.G., Bilgre, B.A., Sanders, A.M., Dudzinski, K.M. In prep. Prediction and management of high-risk behavior in a lone, sociable bottlenose dolphin. (*target: Mar. Mamm. Sci.*)

POPULAR PAPERS:

- Dudzinski, K.M., Perrine, D. 1997. Dolphins behaving badly? Dive International Magazine. December Issue.
- Amano, M., Barbosa, C., Dudzinski, K.M., Kawaguchi, N., Kikuchi, K., Mori, K., Moyer, J.T., Orams, M.C., Soeda, R., Taguchi, S., Yoshioka, M. 1998. Interactions with dolphins and whales. Japanese Publishers & sponsored by Omega. 57 pp.
- Dudzinski, K. M. 1998. The best kept secret in dolphin swim programs. Whalewatcher. Fall/Winter. 6 pp.
- Dudzinski, K.M. 1997, 1998. Summary newsletters of my dolphin research for Miyake's people. Distributed four times per year. Three editions given out. Written in English and Japanese. Each about two pages long. Eight issues distributed.
- Dudzinski, K.M. Douaze, E., Thomas, J.A. (In prep.). Communication. An invited chapter in Encyclopedia of Marine Mammals (W.F. Perrin, B. Würsig, & H.C.M. Thewissen, eds.). Academic Press, Inc., New York, NY.
- Dudzinski, K.M. (In press) Meeting dolphin: my adventures in the sea. National Geographic Publications. National Geographic Society, Washington D.C.
- Dudzinski, K.M., Strain, J. (submitted.) The other side. (a children's short story).

ABSTRACTS/CONFERENCES

- Dudzinski, K.M., Newborough, D. 1997. Concurrent recording of dolphin behaviors, frequency-modulated tones, and pulsed vocalizations (including echolocation clicks) underwater with a swimmer-propelled system. Abstracts of the Underwater Bio-Sonar Systems and Bioacoustics Symposium, Underwater Acoustics Group, Loughborough, England, 16-17 December 1997.
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- Dudzinski, K. M. 1998. Dolphin communication - observations on signal exchange, posture and approach. Proceedings of the Seventh International Dolphin and Whale Conference, Tokyo, Japan, 28 - 29 March 1998.
- Dudzinski, K.M. 1998. Dolphin communication - examples from the Bahamas spotted dolphins and the Mikurajima bottlenose dolphins. Ogasawara 30th Anniversary Symposium. Chichijima, Ogasawara, Japan, 14-18 April 1998.
- Dudzinski, K. M. 1998. Dolphin watching/swimming programs - true ecotourism, simple fun or both. Fifth Anniversary International Symposium on Island Birds and Ecotourism. Miyake, Japan, 13 - 15 May 1998.
- Dudzinski, K. M. 1998. Intraspecific interactions among dolphins: signal exchange via contact behavior and vocalizations. 78th Annual Society for Mammalogy Meeting. Blacksburg, Virginia, 6-10 June 1998.
- Dudzinski, K.M. 1998. Ecological watching program from Miyake - dolphins around Mikurajima. International Dolphin and Whale Ecological Workshop Series, Miyakejima, Japan, 9 - 12 July 1998
- Dudzinski, K.M. 1998. Behavior and signal exchange among individual dolphins. Omega's First Annual Dolphin Symposium. Tokyo, Japan, 17 July 1998
- Dudzinski, K. M. 1999. Production and use of frequency-modulated tones recorded from bottlenose dolphins (*Tursiops truncatus*) found around Mikura Island, Japan. Abstracts of the 13th Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii, 29 Nov. – 3 Dec. 1999.
- Young, S. T., Dudzinski, K. M. 1999. A characterization of the mother-calf relationship in bottlenose dolphins (*Tursiops truncatus*) around Mikurajima, Japan - with a focus on their behavioral exchanges, physical contact and relative positions. Abstracts of the 13th Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii, 29 Nov. – 3 Dec. 1999.

MANUSCRIPTS IN PREPARATION FROM “MIKURA DOLPHIN DATA”

(WITH PLANS FOR MANUSCRIPTS TO BE SUBMITTED BEFORE MARCH 2000)

- Dudzinski, K. M., Douaze, E., Ding, W. in prep. Bottlenose dolphin whistle contours – examinations of signature and whistle repertoire hypotheses and related procedures for classifying whistles to categories from a free-ranging population. (target journal: Animal Behavior).
- Dudzinski, K. M., Ribic, C. A. in prep. Comparative analyses of signal exchange and expression between individual bottlenose dolphins (*Tursiops truncatus*) from Japan and Atlantic spotted dolphins (*Stenella frontalis*) in the Bahamas. (target journal: Behaviour or Ethology)
- Dudzinski, K. M., Fertl, D. C., Uzu, T., Shimomaki, M., Hashimoto, T., Young, S. in prep. Bottlenose dolphins (*Tursiops truncatus*) around Mikura Island, Japan: site fidelity, association coefficients, calving intervals and population estimates. (target journal: Marine Mammal Science)
- Kennedy, M., Dudzinski, K. M. In prep. Play solicitation and play behaviors in dolphins. (target journal: Aquatic Mammals)

APPENDIX 1

Copies of the several of my articles, abstracts or summaries are included at the end of this report for reference to the reviewer. Some popular papers and manuscripts that are either *in press* or *submitted* are not included. Those that are included are listed below.

PEER-REVIEWED ARTICLES/PROCEEDINGS:

- Dudzinski, K. M., Newborough, D. 1997. Concurrent recording of dolphin behaviors, frequency-modulated tones, and pulsed vocalizations (including echolocation clicks) underwater with a swimmer-propelled system. Proceedings of The Underwater Bio-Sonar Systems and Bioacoustics Symposium, Underwater Acoustics Group, Loughborough, England, 16-17 December 1997.
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