

Successful maintenance and research with a formerly stranded Risso's dolphin (*Grampus griseus*)

Paul E. Nachtigall¹, Jeff L. Pawloski², J. Pete Schroeder¹ and Sue Sinclair³

¹Naval Ocean Systems Center, Hawaii Laboratory, P.O. Box 997, Kailua, HI 96734-0997, USA

²SEACO, 146 Hekili St., Kailua, HI 96734 USA

³New England Aquarium, present address: 41 Plymouth Ave., Swampscott, MA 01907, USA

Abstract

A stranded female Risso's dolphin was recovered from a mud flat near Boston, Massachusetts, and rehabilitated by the team at New England Aquarium. Microbiological studies revealed a number of potential pathogens, and the *Grampus* was successfully treated with antibiotics. She was transferred to the Naval Ocean Systems Center's Hawaii Laboratory and has since been maintained there for over six years. We have quantified the number of calories required to maintain the animal's weight of 341 kg, examined and described the functioning of her eyes, failed to demonstrate echolocation, found high frequency hearing deficits as compared to other cetaceans, and demonstrated flexible trainability. This *Grampus* demonstrates that stranded animals can be a valuable resource for obtaining information about a species.

Introduction

Although once assumed to be rare (Scheville, 1954) Risso's dolphins (*Grampus griseus*) have recently been shown to be abundant (Leatherwood *et al.*, 1980) and widely distributed in tropical and temperate waters ranging in temperature from 28°C to 10°C with occasional sightings in polar regions (Zemskiy, 1980). Social group size is normally small with 75% of the sightings counting less than twenty animals (Leatherwood *et al.*, 1980) and strandings normally occurring individually or in small groups. Strandings are infrequent but have been reported in Hawaii (Consiglieri, 1986)⁴, along the coast of California (Orr, 1965), Florida (Paul, 1965), Mexico (Leatherwood, Hubbs, & Fischer, 1979), Australia (Troughton, 1931), New Zealand (Baker, 1974), Scotland (Anderson, 1903), and England (Hardy, 1942). This paper describes the stranding and sub-

sequent rehabilitation and research with one female *Grampus griseus* recovered from a mud flat at Fore River, Quincy, Massachusetts, 30 August, 1980 (Sinclair, 1981).

Stranding

Three days prior to the recovery, three Risso's dolphins were observed swimming near Boston's General Dynamics Shipyard. Staff members of New England Aquarium were notified by shipyard employees of the dolphins' presence and asked to observe them during the departure of a natural gas tanker, the 'Louisiana'. The tanker left without incident and the animals remained in the area for an additional 24 hours. The following day, the tanker returned with two of the animals riding its bow wave into the slip. One Risso's dolphin left while the other remained in the slip for an additional two days. Personnel from New England Aquarium were called again, to assist in removing the remaining dolphin from the boat slip. They attempted for eight hours to crowd the animal out of the area with a net but were unsuccessful. The animal finally left on its own and the problem appeared resolved. Later that evening, however, a *Grampus* stranded on the mud flats one mile upriver from the shipyard. It was assumed that this was the same animal that had been swimming in the tanker slip. The animal was picked off of the mud flats with a crane and transported to the New England Aquarium. A complete physical examination revealed that the animal had a bacterial infection of unknown origin and hematological evidence of liver damage (Sinclair, 1981). The adult female weighed 258.2 Kg and measured 275 cm from the tip of the beak to the base of the notch between the flukes. Not unexpectedly, the animal initially refused to eat previously frozen squid or herring.

Rehabilitation and treatment

After some coaxing and light forced feeding the animal started eating. Antibiotic therapy was initiated immediately, using the broad spectrum antibiotic

⁴L. D. Consiglieri, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Region, Western Pacific Program Office, P.O. Box 3820, Honolulu, HI 96812, pers. commun. to J. P. Schroeder 1986.

Keflex[®], along with hydrating doses of fresh water and vitamins placed in the animal's food. The animal was given high-calorie herring (*Clupea harengus*) *ad lib* to facilitate weight gain. Antibiotic therapy was continued for four weeks at which time she was found to have clinical signs of pneumonia. Antibiotic therapy was reinstated for an additional two weeks (Sinclair, 1981).

The dolphin was gradually placed with several *Tursiops* and apparent play behavior became commonplace. Copulation was observed between the female *Grampus* and the male *Tursiops*. Copulation between a male *Grampus* and a female *Tursiops*, resulting in live intergeneric births, has been previously reported (Sylvestre & Tasaka, 1985). The *Grampus*' appetite quickly recovered, at one point the animal consumed 25 kg of fish in one day. Weight during the first year of captivity increased from 259.2 kg to 321.8 kg, length remained constant at 275 cm.

The animal gradually became more aggressive towards the other animals and started interfering with the programs at the New England Aquarium. At this point the decision was made to train her to swim through the gate so that she could be placed in a holding pen during the programs. Surprisingly, this task was not an easy one. The animal was not reluctant to swim through the gate, the difficulty rested with the fact that the gate was underwater, and she did not perceive this opening as a passageway. Oddly, the animal solved this problem much as one gropes for a light switch in the dark. She bounced her head along the tank wall until she located the opening, and then she swam through.

On 30 January 1982 the *Grampus* was transferred to the Naval Ocean Systems Center's Hawaii Laboratory. She was transported by aircraft in a fleeced-lined stretcher suspended within a large waterproof transport box. When the aircraft reached the proper altitude and levelled off, the box was filled with water up to the top of the animal's flippers. The total transport time was 22 hours. Upon arriving in Hawaii the animal was placed in an open-bay pen, swam normally immediately, and began eating thawed herring within five minutes.

Medical aspects

The medical aspects surrounding the stranding are quite interesting. They involve a cetacean species rarely maintained in captivity and there is no data base of blood parameters or microbial flora for reference. Many species of bacteria have been identified from this animal. The initial diagnosis included that of pneumonia. Pneumonia frequently occurs with

stranded cetaceans (Howard *et al.*, 1983). Blowhole cultures, taken at the time of stranding, yielded a variety of bacterial species including: *Vibrio alginolyticus*, *V. parahaemolyticus*, *Pseudomonas putrefaciens*, *Escherichia coli*, *Edwardsiella tarda* and a coagulase positive *Staphylococcus aureus*. Urine cultures presented *V. alginolyticus* and *E. tarda* while fecal swabbing presented both *Vibrio* species noted previously. Both *Vibrio* species were cultured from a superficial lesion on the animal's dorsal fin.

Of particular interest to the staff at New England Aquarium was the presence of *V. alginolyticus* and *V. parahaemolyticus* isolated from areas of her body. Geraci (1987)⁶ indicated that the treatment of this stranded *Grampus* was his introduction to *Vibrio* species as pathogens of marine mammals. Both organisms have been documented as pathogens in man (Blake *et al.*, 1979). Prior to transporting to the Hawaii Laboratory there was concern on the part of both facilities regarding quarantine of the *Grampus*. This prompted a microbial survey of the coastal sea pen water and on dolphins housed at the laboratory. Bacterial cultures, taken from intact skin and superficial lesions, revealed the presence of *V. vulnificus*, *V. marinus*, *V. alginolyticus*, *V. parahaemolyticus*, *V. pelagius II* and *V. damsela* (Greco *et al.*, 1985). Skin lesions grew *V. marinus*, *V. harveyi*, *V. gazogenes*, *V. mechnikovii* and *V. damsela* (Schroeder *et al.*, 1985; Dailey, 1985). *V. alginolyticus* was routinely isolated from the blowholes of healthy *Tursiops* housed at the Hawaii Laboratory. This genus of bacteria was apparently well established in Hawaiian waters prior to the *Grampus*' arrival. These organisms live in salt water, and *V. alginolyticus* has also been found to be the predominant bacterium in water inhabited by dolphins in Hawaii (Fujioka *et al.*, 1986).

The *Grampus*' initial respiratory infection responded to antibiotic therapy at the New England Aquarium, but *V. alginolyticus* and *V. parahaemolyticus* continued to be shed from the blowhole. Upon arrival at the Hawaii laboratory a *Salmonella sp.* and *V. parahaemolyticus* were cultured from the blowhole, and antibiotic therapy (Septra[®])⁷ was immediately instituted. After ten days only *V. alginolyticus* was isolated and the dolphin appeared normal. She remained in good health until July 1985. At that time, culture of lesions in the oral cavity showed a *Proteus sp.* which responded to Amoxicillin[®] followed by Keflex[®]. The mouth lesions healed only to return two weeks later as a *Candida* infection, probably due to the antibiotics reducing the normal bacteria that had been keeping the fungus in check.

⁶J. Geraci, University of Guelph, Guelph, Ontario, Canada N1G2W1, pers. commun. to Nachtigall 1987.

⁷Septra[®]—Burroughs Wellcome Co., Kansas City, MO 64108.

⁸Amoxicillin[®]—Beecham Laboratories, Bristol, TN 37620.

⁵Keflex[®]—Dista Products Co., Division of Eli Lilly and Co., Indianapolis IN 46285.

Table 1. Blood Values Recorded from a *Grampus griseus* 1982 to 1987

Test	Unit	Mean	SD	Range	n
HEMATOLOGY					
WBC	10 ³ /mm ³	10.0	4.8	6-29	82
SEGS	%	77.6	8.0	54-95	82
bands	%	2.5	2.0	0-22	82
lymphs	%	17.0	7.0	5-41	82
monos	%	0.4	0.4	0-4	82
eos	%	2.1	2.0	0-18	82
RBC	10 ⁶	4.5	0.37	3.8-5.4	81
Hbg	g/dl	17.5	1.4	14.7-20.3	81
HCT	%	50.3	4.2	41.7-57.6	81
SERUM ENZYMES					
Triglyceride	mg/d/	139.0	65.0	33-327	58
LDH	U/L	548.7	120.2	74-732	61
SGOT	U/L	300.6	73.0	184-516	61
SGPT	U/L	109.4	39.0	51-214	61
Alk. Phos.	U/L	123.0	75.0	7-308	65
Cholesterol	mg/dl	345.2	111.0	152-566	59
Bilirubin	mg/dl	0.123	0.05	0-0.3	65
Bili. Indirect	mg/dl	0.091	0.03	0-0.2	36
Bili. Direct	mg/dl	0.016	0.03	0-0.1	36
GGTP	U/L	29.2	7.8	9-43	57
Creatinine	mg/dl	2.07	0.36	1.4-2.8	65
CPK	mu/ml	73.0	40.0	48-154	7
SERUM CHEMISTRY					
Osmolality	mOsm/l	330.0	6.0	320-340	10
Na	mEq/l	150.0	3.7	139-159	65
K	mEq/l	3.7	1.0	2.8-10	65
Cl	mEq/l	113.0	4.2	104-126	65
Ca	mg/dl	8.7	0.4	7.6-10	63
PHOS	mg/dl	4.6	1.0	2.7-9.8	59
BUN	mg/dl	49.0	7.0	36-69	65
Uric acid	mg/dl	0.37	0.24	0-1.2	60
Glucose	mg/dl	165.0	22.0	115-216	65
ADDITIONAL ANALYSES					
Total Protein	g/dl	7.1	0.4	6.3-8	65
Albumin	g/dl	3.9	0.3	3.5-4.9	65
Globulin	g/dl	3.1	0.4	2.4-4.2	65
A/G Ratio		1.3	0.2	0.9-2	65
SED Rate—60 minutes		14.9	4.6	10-22	13
Progesterone depends on cycle stage				0.25-22.3	40

The lesions responded well to a combination of antibiotic and antifungal therapy and the *Grampus* continued to remain in good health up until August of 1987. At that time, she became anorexic although she was alert and worked with some interest in her training sessions. Lesions were again noted in her oral cavity, and blowhole cultures revealed *V. parahae-molyticus*. She continued to refuse food and was force fed for seven days. This was the first time at the Hawaii Laboratory that she required force feeding.

She once again rebounded to sound health after Keflex® therapy and has developed no further problems.

Interpretation of hematological values has been somewhat difficult due to the unavailability of baseline data for this species. A reliable set of hematological values has been obtained for this dolphin during the six years at the Hawaii Laboratory. Serum chemistry measurements (Table 1) are within the normal range for most of the frequently measured

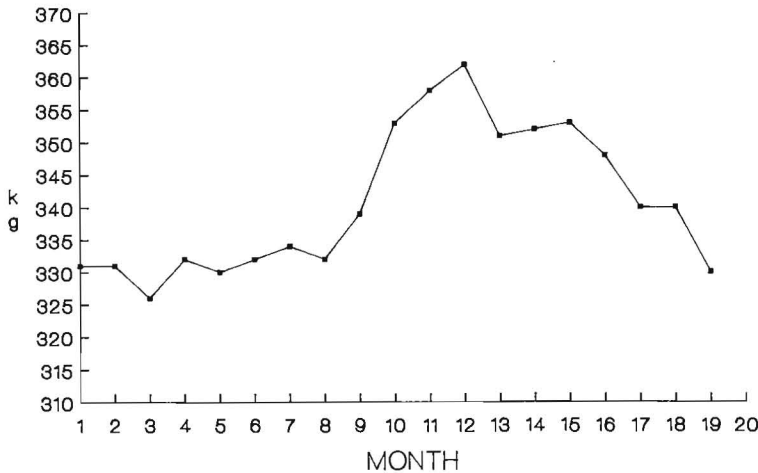


Figure 1. Monthly weight of the *Grampus* from March 1986 to September 1987.

Tursiops values, (Geraci, 1980; Ridgway, 1972) except for elevated liver enzymes, lactic dehydrogenase (LDH), serum glutamic pyruvic transaminase (SGPT), serum glutamic oxalacetic transaminase (SGOT), alkaline phosphatase and cholesterol. These levels may, in fact, be normal for *Grampus griseus*. The animal's general behavior and appetite have remained normal except during times of bacterial infection as previously noted. The Dall's porpoise (*Phocoenoides dalli*) has shown elevated levels of these enzymes in a range similar to that of this particular *Grampus* (Ridgway, 1972; Boever & Wallach, 1983).

It's important to remember the condition existing at this dolphin's stranding. A trained team recovered the animal quickly before a great deal of physical damage had occurred. Rapid diagnosis of medical condition, immediate veterinary care, and housing with other small cetaceans provided an environment suitable for this *Grampus* to survive and recover.

Maintenance and research

During the weight-gain phase of the animal's recovery at New England Aquarium, she consumed an average of 15 479 Kcal per day (Sinclair, 1981). A weight of 340.9 kg is currently maintained by feeding 15 681 Kcal per day. The animal has been weighed once per month since May of 1984; the weight record is presented in Figure 1. Her length has remained 275 cm. A complete physical examination has been performed at least once every six months. Blood samples are obtained with the cooperation of the animal. In response to a hand signal, she presents her flukes and remains motionless. The flukes are placed on the edge of her floating pen deck, supported by a foam mat, and positioned so that a blood vessel can be located. Typically, 50 or 60 cc of blood can be

drawn before hemostasis. The flukes are then released and the animal is rewarded with a fish. The entire procedure takes between three and six minutes. The animal voluntarily and reliably performs this behavior.

Echolocation

Risso's dolphins present a fascinating anatomical picture for those interested in animal echolocation. Cetacean melons are believed to be sound projectors for echolocation clicks (Wood, 1964) and most odontocete species have rounded melons. The *Grampus*, on the other hand, has a distinct bifurcation, or crease, extending from near the blowhole to the top of the mouth. It is not unreasonable to speculate that this peculiar anatomical structure may create two sources of sound that interact to propagate highly directed echolocation signals. This speculation fueled the interest to begin echolocation experiments soon after the animal's arrival in Hawaii. Unfortunately despite arduous efforts of two experienced trainers, no evidence for echolocation was obtained. Although no behavioral audiogram for this species has yet been obtained, an evoked-potential audiogram collected by S. Ridgway⁹ and D. Carder revealed that the animal heard high frequencies like other odontocetes, but thresholds appeared greatly elevated at high frequencies. This animal apparently does not hear as well as other cetaceans and therefore echolocation cannot be appropriately tested.

Vision

Ophthalmological examination of the *Grampus*' eyes was completed during the summer of 1985 (Dawson

⁹S. Ridgway, Naval Ocean Systems Center, San Diego, CA 92152, pers. commun. to Nachtigall November 1987.

et al., 1987). The animal was premedicated with 0.3 mg/kg of diazepam administered orally and taken into a laboratory, with controlled light conditions. She was fitted with a 'reverse goggle' designed by W. Dawson to keep the eye in a seawater medium during the exam. The pupil dilated under low light conditions allowing the opportunity to examine the interior of the eye. The animal's eyes were shown to be healthy without evidence of active eye disease and demonstrated a remarkable accommodative stability. Colour fundus photographs revealed that *Grampus* and *Tursiops* eyes differed dramatically in the transmittance of light of differing wavelengths. The *Grampus* had an increased transmittance of blue (short wavelength). Accurate fundus photographs show an observedly yellow fundus for *Tursiops* and a predominantly blue-red fundus for *Grampus*.

Psychophysical examination

The determination of how well an animal resolves fine detail visually is most often accomplished by training the animal to report the perception of black and white striped lines on standard Ronchi rulings. Quantitative measures of visual acuity may be obtained as minimum angles of resolution in order to compare visual functioning in air and under water (Herman et al., 1975) and across species (Nachtigall, 1986). The *Grampus* has been trained to position her head out of water and to look at two simultaneously presented Ronchi rulings. Both rulings are composed of 25.4 × 25.4 cm two-dimensional grids which have alternating black and white stripes of equal line thickness. On one, the stripes are so small as to appear grey, on the other the stripes are clearly visible. The animal chooses the ruling with obvious black and white stripes by pressing a paddle located under the ruling. Rulings of varying stripe widths are being presented to determine the animal's threshold or minimum angle of resolution.

This once-stranded *Grampus griseus* continues to contribute to our knowledge of her species. Since her stranding and rehabilitation we have recorded the number of calories it takes to maintain a Risso's dolphin and thus have a good number for estimating the food needs of a population of her species. We have reliable blood values and a knowledge of which microorganisms may cause disease; a better understanding of the morphology and function of *Grampus* eyes, and are continuing to develop an appreciation for the animal's trainability and visual capabilities. Many questions about Risso's dolphins remain unanswered but the opportunity to work with this animal has allowed us to learn much about the basic physiology and sensory abilities of at least one member of this species.

Literature cited

- Anderson, R. J. (1903). Notes on the skull of *Grampus griseus* found on the coast near Galway. British Assoc for the Advancement of Science, p. 691-692.
- Baker, A. N. (1974). Risso's dolphin in New Zealand waters, and the identity of 'Pelorus Jack'. *Rec. Dom. Wellington* 8, 267-276.
- Blake, P. A., Merson, M. H., Weaver, R. E., Hollis, D. G. & Heublein, P. C. (1979). Diseases caused by marine vibrios. *The New England Journal of Medicine* 300(1), 1-5.
- Boever, W. J. & Wallach, J. D. (1983). Diseases of exotic animals. Second Edition. W. B. Saunders Co., Philadelphia, PA.
- Buchanan, R. E. & Gibbons, N. E. (1974). Bergey's manual of determinative bacteriology. 8th Edition. The Williams and Wilkins Co., Baltimore, MD, 346 p.
- Dailey, M. D. (1985). Diseases of Mammalia: Cetacea. In O. Kinne (editor), Diseases of marine animals, Vol. IV, Part 2, p. 804-847.
- Dawson, W. W., Schroeder, J. P. & Dawson, J. F. (1987). The ocular fundus of two cetaceans. *Marine Mammal Science* 3(1), 1-13.
- Fujioka, R. S., Greco, S. B., Cates, M. B. & Schroeder, J. P. (1986). Vibrio spp. associated with wounds from bottlenose dolphins housed in sea pens. 86th annual meeting, American Society of Microbiology, March 23-28, Washington, D.C., 94 p. (Abstract).
- Geraci, J. R. (1981). Marine mammal Care. Published by J. R. Geraci, Guelph, Ontario, Canada.
- Greco, S. B., Fujioka, R. S., Cates, M. B. & Schroeder, J. P. (1985). Assessing the concentrations and significance of vibrio bacteria in pens used to house marine mammals. Proceedings of the International Association for Aquatic Animal Medicine 1(2), 139-145.
- Hardy, E. (1942). Records of Lancashire cetaceans. *Nature*, Vol. 150, No. 3808, 492 p.
- Herman, L. M., Peacock, M. F., Yunker, M. P. & Madsen, C. J. (1975). Bottlenosed dolphin: double-split pupil yields equivalent aerial and underwater diurnal acuity. *Science*, 189, p. 650-652.
- Howard, E. B., Britt, J. O., Matsumoto, G. K., Itahara, R. & Nagano, C. (1983). Pathobiology of marine mammals. Vol II, CRC Press, Boca Raton, FL, 73 p.
- Leatherwood, S., Hubbs, C. L. & Fischer, M. (1979). First records of Risso's dolphin, *Grampus griseus*, from the Gulf of California with detailed notes on a mass stranding. *Trans. San Diego Soc. Nat. Hist.* 19, 45-52.
- Leatherwood, S., Perrin, W. F., Kirby, V. L., Hubbs, C. L. & Dahlheim, M. (1980). Distribution and movements of Risso's dolphin, *Grampus griseus*, in the eastern North Pacific. *Fishery Bulletin* 77(4), 951-963.
- Nachtigall, P. E. (1986). Vision, audition, and chemoreception in dolphins and other marine mammals. In: R. J. Schusterman, J. A. Thomas, F. G. Wood (eds.), Dolphin cognition and behavior: a comparative approach. Lawrence Erlbaum Associates, Inc., NJ., p. 79-113.
- Orr, R. T. (1965). Risso's dolphin on the Pacific Coast of North America. *J. Mammal.* 47(2), 341-343.
- Paul, J. R. (1965). Risso's dolphin, *Grampus griseus*, in the Gulf of Mexico. *J. Mammal.* 49(4), 746-748.
- Ridgway, S. H. (1972). Mammals of the Sea Biology and Medicine. Charles C. Thomas, Springfield, IL, p. 653-665.

- Scheville, W. E. (1954). Sight records of the gray grampus, *Grampus griseus* (Cuvier). *J. Mammal.* **35**(1), 123–124.
- Schroeder, J. P., Wallace, J. G., Cates, M. B. & Moore, P. W. B. (1985). An infection of *Vibrio alginolyticus* in an Atlantic bottlenose dolphin housed in an open ocean pen. *J. of Wildlife Diseases* **21**(4), 437–438.
- Sinclair, S. (1981). The rehabilitation of a stranded grampus (*Grampus griseus*). In: J. Barry and R. Brill (eds.), Proceedings of the International Marine Animal Trainers Association Conference, p. 3–8. Niagara Falls, NY.
- Sylvestre, J. & Tasaka, S. (1985). On the intergeneric hybrids in cetaceans. *Aquatic Mammals* **11**(3), 101–108.
- Troughton, E. L. G. (1931). The occurrence of a male and female *Grampus griseus* (Delphinidae) at Sydney, N.S.W. *Zool. Soc. London Proc.*, p. 565–570.
- Wood, F. G. (1964). Discussion. In: W. Tabolga (ed.), *Marine Bioacoustics*. New York: Pergamon Press.
- Zemskiy, V. A. (1980). Atlas of marine mammals of the USSR. Pishchevaya Promyshlennost Pub. House Moscow, 184 p.