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Advances in Husbandry Training in Marine Mammal Care Programs

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The aim of this paper is to illustrate how the training of marine mammals has facilitated improved marine mammal husbandry practices. The marine mammal community has seen many changes, refinements and improvements in animal care programs since the first marine mammals were brought in captivity in the early 19th century. Cross disciplinary fields such as veterinarian science, psychology, physiology and conservation biology have advanced the knowledge and care of the different species of cetaceans, pinnipeds, sirenians and otters and brought marine mammal care programs to the standard they are today. In this paper a broad overview is given of the main advances in husbandry training in marine mammal care programs worldwide.

It has been nearly 80 years since the initial behavior and performance study on Atlantic bottlenose dolphins (*Tursiops truncatus*) was conducted by Mr. Arthur McBride who was the first curator of Marine Studios. At Marine Studios in Florida he kept records of the care, behavior and performance of the animals under his care by creating the foundation of what we take for granted today: a review of the natural history of Atlantic bottlenose dolphins (Hurley, Messinger, Rosenberg, & Roberts, 2007). Since then the continuous advancement of medical and husbandry knowledge (e.g., Dierauf & Gulland, 2001; Ridgway, 1972) and the implementation of behavioral learning principles have contributed to a great improvement of contemporary marine mammal husbandry programs. Marine mammal care programs are defined as all encompassing, ensuring the welfare of the animal. Maintaining healthy animals who collaborated voluntarily in their health care needed the practical application of behavioral learning principles combined with record keeping, communication and patience. The toolkit available to marine mammal trainers from a theoretical perspective also needed expansion.

In the mid sixties the late Dr. Scott Johnson obtained voluntary blood samples (ITAC, 2003) and K. Breland introduced the *bridging stimulus*, *reinforce* and *extinction* to marine mammal training (ITAC, 2003). Since, the marine mammal community has been continuously exploring and improving different methods of working with marine mammals. Basic marine mammal training terminology and techniques are defined and explained (Beeler, 1996), the IMATA Glossary with basic and advanced training terminology (IMATA, 2004) and a

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discussion on a potential definition drift when not using correct terminology (van der Toorn, 1996). Many books have been written on animal training such as *Don't Shoot the Dog* (Pryor, 1999) and *Animal Training: Successful Management through Positive Reinforcement* (Ramirez, 1999). Terminology used in comparative psychology such as approximation, association, generalization, habituation, classical conditioning, observational learning, operant conditioning, shaping, orient response, discrimination, extinction, schedules of reinforcement, secondary reinforcer are all discussed in marine mammal training publications (de Groot, 1990; Kastelein, 1990; Pryor, 1975, 1995; Ramirez, 1999; Turner, 2002). These methods and techniques have all been used to benefit the development of health care programs which allow for preventive and regular health screening of marine mammals under human care. Initially, the training of marine mammals was motivated by entertainment industry and research outcomes but soon it became clear that the different training methods applied to the daily care as well. This brought huge benefits for animals and their care as well as for education, research and conservation purposes. Husbandry behaviors such as dental work, blood draws, mammary presentation and milk collection, urine collection and voluntary semen collection have all been trained with marine mammals (Krames, 1984; Lacinak, Scarpuzzi, Force, & McHugh, 1996; Odell & Robeck, 2002; Ramirez, 1994) bringing many benefits in the form of preventive, active and reactive health care. Marine mammals could be taught not only to perform for the public but more importantly, they could be taught to participate in their own medical care and husbandry.

Animal Learning

Changes in behavior occur due to changes in motivation or physical conditions, such as hunger, without learning taking place. The animals' instincts, biology and the individual variations should be taken into account, as they are likely to affect the way they learn (McGreevey & Boakes, 2007). The marine mammal community continuously reviews the current methods of training, applying behavioral learning more effectively. To improve and build good relationships based on trust with the animals there has been a shift away from unacceptable practices (Turner & Tompkins, 1990). Punishment is used to decrease the frequency of undesired behaviors (Walters & Grusec, 1977). The use of severe punishment can result in a decrease of overall behavioral activity or increase aggressive behavior (Azrin, 1960). Many marine mammals are trained in a free contact scenario where trainer and animal have full access to one another. Therefore, in this context, the use of punishment could lead to dangerous situations when working in such close proximity (Turner & Tompkins, 1990). Training methods with frequent use of punishers and other aversive methods have been modified, by reducing or abolishing the use of punishers in many facilities. Focusing on positive reinforcement training allows the caregiver to build trust and a bond with the animals, while at the same time promoting the desired behaviors and creating a stimulating, interesting and safe learning environment. In traditional operant conditioning, for example food deprivation was often used to motivate the animals, whereas in other cases, animals were placed in social isolation and

received limited human contact because of aberrant behavior (personal observations). Instead, the marine mammal community is focusing on building relationships based on positive engagement with an emphasis on positive reinforcement. Marine mammal trainers are not only concerned with the correct application of behavioral learning principles but they also pay attention to and consider the effect of human body language, posture and communication on the animals in their care (Davis & Harris, 2006). For an extensive overview on marine animal training please see Kuczaj and Xitco (2002).

Although there are many theories through which animals can learn, this paper focuses mainly on operant conditioning and positive reinforcement as it applies to daily husbandry and medical care procedures. Reinforcement is used to increase the frequency of desired behaviors (Skinner, 1938). Positive reinforcement is the addition of a desired reinforcer to the animal's environment. A primary reinforcers is an unconditioned reinforcer, anything of intrinsic value to an organism (IMATA, 2004) and a secondary reinforcer is a reinforcer that has acquired reinforcing value through learning by being paired with events that are already reinforcing, also called a conditioned reinforcer (IMATA, 2004).

Marine mammal trainers use primary reinforcers but also discovered and know the importance of the secondary reinforcer (Flaherty Clark, Messinger, & Messinger, 2010; Ramirez, 1994). Modern marine mammal training relies on reinforcement alone (Ramirez, 1999; Turner, 2002). When positive reinforcement is applied correctly, we see an increase in the frequency of the behavior reinforced. Marine mammal trainers spend a lot of time observing and working with the animals, not only because it is a pleasurable experience but also to gain insight in what motivates and can be used to reinforce an individual. Marine mammal trainers have long studied the preferences of the animals under their care, as individuals and groups to ensure that the positive reinforcement provided is of value to the animals. Reinforcements used in training marine mammals can be primary (i.e., fish and social contact), or secondary (i.e., toys and environmental change) (Burrows, Schreib, & Smith, 1990; Ramirez, 1994). The variety and quantity of positive reinforcers offered during a training session is also important. Different reinforcers have been combined with the use of different types of reinforcement schedules and have successfully been applied in both training and enrichment programs (Abel, Okazaki, Tatsukawa, & Kawamura, 2006; Brill, 1981; Kuczaj, Lacinak, & Turner, 1998).

The number of papers presented at the International Marine Animal Trainers Association (IMATA) annual conference, the industry's leading community of trainers, has increased and many are subsequently published in IMATA's journal *Soundings* contributing to a wider audience learning about marine mammal training. Peer reviewed journals like Aquatic Mammals publish numerous papers on marine mammal husbandry and many oral and poster presentation are presented at the European Association for Aquatic Mammals (EAAM), Society for Marine Mammology (SMM) and International Association for Aquatic Animal Medicine (IAAAM) conferences. Topics vary from artificial insemination (A. I.) (Keller, 1986; Neto, Silveira, Salbany, Camacho, & Quintino, 2008; Robeck, 2007) and voluntary blood collection (Harsaw, 2000; see Fig. 1) to caring for geriatric animals (Burtis, Garver, Hoffman, & Roberts, 2008; Negrini,

2000) and voluntary biopsies and operations (Collins, Lambert, & Renner, 2010; Massei, Ova, Salbany, Roque, & Lacave, 2005). Another wonderful tool in sharing what is possible with marine mammals husbandry is the thorough overview of medical behaviors with three species of marine mammals which can be viewed on DVD through the visual encyclopedia documented by Zoomarine (2007).

The marine mammal community continues to strive to learn and research further, but also to review the basics and acknowledge that there is so much still to learn and to investigate. Continuing to refine and investigate as we still know too little about the mechanisms in marine mammal training (Bauer, 2002, 2009). This refinement can be achieved by increasing the 'trainer's toolkit', increasing knowledge of the different learning principles and their effects, and arguing for more research (Bauer, 2002, 2009).

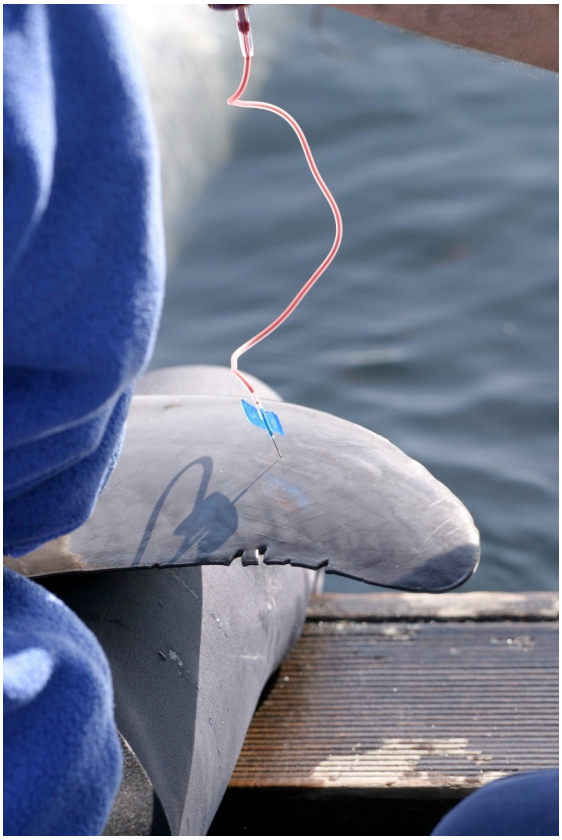

Figure 1. Voluntary blood collection with a bottlenose dolphin (*Tursiops truncatus*).

Marine Mammal Husbandry

A marine mammal husbandry program should include behavioral, psychological and physiological components. A complete husbandry program includes a combination of different aspects from a variety of disciplines but should

cover species – specific nutrition, environment, handling and transport procedures. Other husbandry areas, apart from the obvious physical health care, are animal behavior, learning and emotions, as well as environmental enrichment to facilitate exercise and mental stimulation. Additional components are staff and communication, record keeping and the human – animal relationship. Husbandry programs should include all of these components but it is important to note that there are many different programs in the marine mammal field, from basic to very advanced levels. Programs need to be designed to be species-specific and to take consideration of human and animal safety as well as potential reintroduction needs. We might work through free contact, where an animal has full access to the trainer and vice versa or in semi-protected or protected contact scenarios like the husbandry programs for Steller sea lions (*Eumetopias jubatus*) at the Harderwijk Dolfinarium in the Netherlands (see Fig. 2). To ensure the reintroduction needs are met for temporarily housed Steller sea lions at Sea Life Center in Seward, Alaska another forms of training can be used (Mellish et al., 2006). Remote conditioning is when no relationship should be developed between the animals and the trainers (IMATA, 2004). Remote conditioning can be one of the methods which aids in the goal towards minimizing exposure and habitation to humans, for an extensive overview on research training for releasable animals see Bauer (2005).

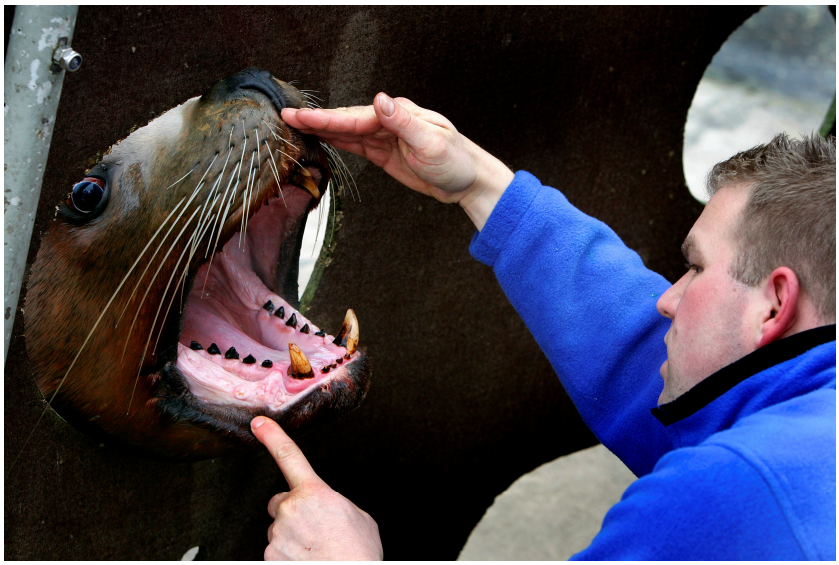

Figure 2. Mouth examination through semi-protected contact training with a Steller sea lion (*Eumetopias jubatus*).

Ramirez proposes that “training is teaching” (1999, p. 8). By teaching animals to participate in their daily health and husbandry care the stress that can be related to these procedures (Desportes et al., 2007) can be significantly reduced. Group management is of fundamental importance within the different types and sizes of facilities and the variety of species housed (Aibel, 1993; Clarke & Brill,

1979; Flaherty Clark, McCullough, & McCoy, 2003; Force & Bellows, 1991; Harshaw, 2000; Laule & Desmond, 1991; Travid, 1998; Trupo & Blasko, 1985). Marine mammals can learn through training to move on and off exhibit, enter crates and tunnels for transport (Loufek & Pereyra, 2008; Ramirez, 1992), or to allow weighing (Loufek & Pereyra, 2008; Mellish et al., 2006). Marine mammals have been trained for gastric tube hydration (Flaherty Clark, Messinger, & Messinger, 2010; Sweeney, 1984; see Fig. 3) and transesophageal echocardiographic evaluation representing the single most important tool for the evaluation of mammalian cardiac structure and function (Sklansky, Levine, West, Havlis, & Stone, 2006).

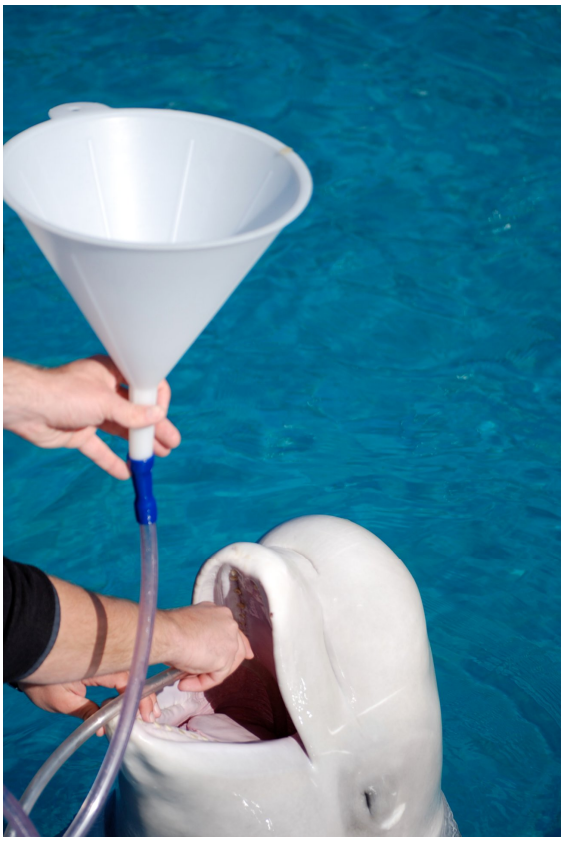

Figure 3. Hydration with a beluga whale (*Delphinapterus leucas*).

A Californian sea lion (*Zalophus californianus*) diagnosed with hyperglycemia was trained to allow for small quantities of blood, "beads", to be collected from the flippers to determine a fasted blood glucose value, to accept intramuscular insulin injections and for urine collection (Loschiavo & Richard, 2009). Other behaviors can be urine collection (Lenzi, 2001), fecal collection and stethoscope examinations (Sweeney, 1984), blood collection and sedation (Harshaw, 2000). Marine mammals can suffer from dental problems which need

daily or regular attention such as brushing, flushing, and cleaning with a dental pick and or water jet. Training of behaviors that facilitates dental care is especially valuable in killer whales (*Orcinus orca*) (Graham & Dow, 1990). Captive breeding programs have come a long way due to animals participating in voluntary A. I. and semen collection (Keller, 1986; Neto et al., 2008; Robeck, 2007). An advantage of using A. I. is that we can keep social groups intact as only the semen is moved from facility to facility. Importantly, we not only decrease the stress related to procedures but we also increase the motivation of marine mammals to participate in pre-trained procedures. None of these voluntary husbandry behaviors would be possible without training and a rewarding human-animal relationship through animal–trainer interactions. Marine mammal trainers also provide environmental enrichment activities and physical exercise. All these interactions change the relationship we build and have with our animals on a daily basis. Building a trusting and caring relationship, teaching the different procedures on cue and establishing strong reinforcement histories with our animals, enabling them to behave in a secure manner and provide the ability to anticipate what is happening to them, whether good or bad.

By teaching animals to participate in their daily care they gain more control and choice over their environment. We have the means to offer the opportunity to participate and collaborate with us, rather than imposing procedures on them. By using behavioral learning principles we have increased the welfare standard of the animals under our care, by being concerned about the mental and physical health.

One of the key factors for trainers is to find ways to continuously motivate and engage the animals, providing a safe but also interesting and challenging environment. Animal care and training staff need to stay creative but also be sensitive and respectful when an animal decides not to participate. Marine mammal trainers should always investigate and refine their skills and knowledge with regards to animal welfare and learning, asking question concerning animal motivation, failures and learning. “To develop and maintain an animal’s positive attitude towards learning....this means that the trainer cares about the overall learning experience of the animal....” (Sullivan, 2002 p. 30).

The choice for the animal should be more than the sole option to participate. It is then our responsibility to evaluate the situation, ask questions about why the animal refuses and to find a solution to the problem, which might be medical, social, contextual or through boredom and disinterest. However, it is important to focus on positive methods and to build trust, even in periods of non-cooperation.

“We should work with animals as if gates and doors weren’t there; as if they could leave any moment they wanted. If they then decide to stay and work with you, then you can say you have a good bond and trust and is the animal truly interested in being with you” (J. McBain, personal communication, March 13, 2008).

Medical Training and Behaviors

Advances in the medical and husbandry have contributed to the health and management of marine mammals under human care (Dierauf & Gulland, 2001; Ridgway, 1972). The training of behaviors to aid in the health care was a leap forward in the daily care and husbandry of marine mammals in captivity and has become an extremely important tool. By training the animals to collaborate voluntarily in their health care the veterinarians and trainers have the possibility to practice preventive medical care as well as reactive care. Marine mammals can learn to associate different behaviors with different stimuli, which if done correctly result in reinforcement. These stimuli are called discriminative stimuli as they allow the animal to discriminate between the different stimuli and the related behaviors. Many animals continue to respond to previously learned stimuli for different medical behaviors even when ill. It also allows us to care and medicate animals needing long-term treatment due to medical conditions (Stacey et al., 1999). By having the animals participate in daily training sessions we can monitor the animals closely, do frequent body inspections such as mouth, eye and body condition checks, obtain regular weights and monitor precise food intake. More complex and advanced behaviors include urine collection (Lenzi, 2001) and cystoscopy (de Sousa & Lacave, 1998), fecal collection (Sweeney, 1984), semen collection and A. I. (Keller, 1986; Neto et al., 2008; Robeck, 2007). Marine mammals predominately live their lives in sea water and still little is known about what effects fresh or salt water might have on their physiology and behavior. Dunn and colleagues (1996) showed that animals in fresh water developed corneal edema and cataracts. Colitz and colleagues write that "diseases of the cornea and lens are common in captive pinnipeds; environmental factors including water quality and salinity, light intensity, nutrition, and spatial characteristics (e.g. orientation of sun on wet and dry areas, depth, exhibit surface color [for reflected light], and animal loading per cubic meter [because of potential water-quality effects] have been reported ... in these species."(personal communication, August 13, 2010) In this study more than a hundred animals participated voluntarily in ophthalmic examinations to aid in the data collection investigating risk factors associated with cataracts and lens luxations (Colitz et al., 2010a). A similar population of captive pinnipeds was evaluated and allowed characterization of progressive keratitis in Otariids (Colitz et al., 2010b). Marine mammals have been trained for voluntary husbandry behaviors allowing the eyes to be examined such as opening the eyes and keeping this open even when approaching with equipment or medication, using ophthalmoscopes (indirect) and ultrasound as well as applying medication, such as eye drops (Fig. 4), when required (Kwok & Ng, 2007). Older animals can benefit from specially designed geriatric animal care programs (Burtis, et al. 2008; Negrini, 2000), voluntary biopsies can help in the diagnose of skin diseases (Massei et al., 2005), and post-operative care ensures we can closely monitor the healing process (Campbell & Hayward, 2004). Younger animals can benefit from physical exercise and physiotherapy (Scarpuzzi, Andrews, Mcbain, & Reidarson, 2002).

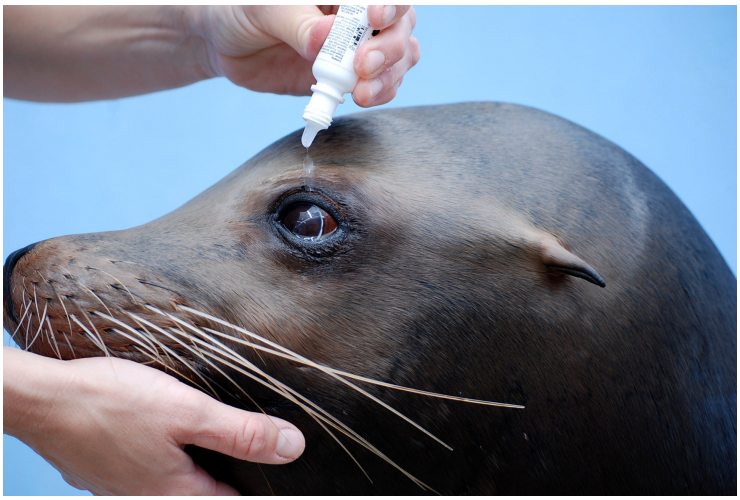

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Figure 4. Eye drops administration with a Californian sea lion (*Zalophus californianus*).

Monitoring pregnancy and neonatal care have also greatly benefited from the application of operant conditioning techniques (Fish, Hoffman, Reidarson, & Scarpuzzi, 2008; Hymer et al., 2005). Marine mammals can learn to position for ultrasound, to measure intermammary distance and girth during prenatal care (Blanchet et al., 2008). Many species of marine mammals are routinely trained for ultrasounds. Real-time diagnostic ultra-sonography provides a means to image the morphology of the reproductive organs in live female and male dolphins directly and provides a valuable means of assessing reproductive events in this species (Brook, 2001; Brook, Kinoshita, Brown, & Metreweli, 2000). As soon as a pregnancy is suspected, animals who are fully trained and desensitized will participate voluntarily in these procedures to monitor the growth and health of the fetus as well as the health of the mother. First time mothers are sometimes taught through positive reinforcement training to guide a dummy baby dolphin to keep it away from the walls as this can result in injuries to the calf (Kastelein & Mosterd, 1995). One female dolphin at the Harderwijk Dolfinarium who had a history of taking her calves into her mouth, and thereby injuring them, was trained to swim with a dummy dolphin alongside her and was trained to release the calf on cue. After releasing the calf another cue was given to her signaling to present the nipple to the calf (Kastelein & Mosterd, 1995).

To ensure a stock of milk in case of emergency or in the unfortunate event of the death of the mother marine mammals have been trained for voluntary milk collection (Kamoinick, Reddy, Miller, Curry, & Ridgway, 1994). Data on the breeding success, calf survival and calf development from the world's longest running study of a wild dolphin population has helped shape the management protocols for captive marine mammal facilities. Further, information on health parameters as body condition and physiological expected ranges for urine, blood

and milk helps to determine health in marine mammals under human care (Wells, 2009).

Another positive outcome of having animals participate voluntarily in their daily care is the reduced number of staff and the reduced amount of time needed to complete day to day activity, this in comparison with the staff and time required when animals do not voluntarily cooperate in the daily or regular husbandry procedures. Additional extensive measures must be taken with uncooperative animals, such as emptying pools while watching over the animals which experience an unnecessary stressful situation. It will reduce the need for catching, darting and chasing, it is less stressful for staff and animals and does not endanger the positive and trusting bond with the animals (Dew, 1976), husbandry training also significantly reduces the chance of injury to animal or handler (Lacinak, Scarpuzzi, Force, & McHugh, 1996). In addition, the risk of drowning is very high when animals are in or accidentally return to the water after anesthesia drugs have been administered, so it is preferable to have aquatic animals voluntarily take part in their husbandry management.

Some of the other advantages to an animal's voluntary participation in preventive healthcare include:

1) Excluding false results due to stress. Desportes and colleagues (2007) reported lower cortisol levels when Harbour porpoises (*Phocoena phocoena*) participated voluntarily in their health care and during blood collections, thereby decreasing the stress related to these procedures.
2) Reducing sampling and treatment time as animals cooperate in the daily or regular health screenings so marine mammals can be diagnosed and treated quickly.
3) Desensitization. Through desensitization we lessen the negative reactions to a variety of procedures. The animal can be trained for serial (highly repetitive) sampling and/or treatment, such as swabs taken from the mouth or several blood samples a day.
4) Building a trusting and positive relationship with the animals through positive interactions, play sessions and building reinforcement history. Opportunities for choice and control over the environment [i.e., choosing to interact with the trainer during sessions, training through small approximations and setting the animal up to succeed and receive reinforcement (Davis & Harris, 2006; Sullivan, 2002)].

Another benefit of marine mammal training is the closer collaboration between veterinarians and animal care staff who have a background in animal behavior and learning. Veterinarians working in close contact with the trainers become more educated on animal behaviour and learning and behavior learning principles, what it takes to maintain voluntary husbandry behaviors and how they could play their part in the husbandry program. At the same time the trainers become more educated on the needs and work of the veterinarian. They learn about how to take and preserve samples and observe and recognize early symptoms of disease and physical or mental discomfort. Due to the trusting relationship between animal and trainer many voluntary samples can now be collected, some by the trainer, others by the veterinarian, as often animals are desensitized to the presence of the veterinarian. The trainers also become a link between the veterinarian and

laboratory staff as they can often send off samples and relay the information and results back to the veterinarian. The trainer becomes the eyes and ears of the veterinarian as well as their link to the animals.

The development of communication in the marine mammal field made the sharing of information accessible to the whole community. Through conferences, publications and personal communications the available techniques, successes and also failures are being shared. People are learning from each other through different media and technologies (J. Sweeney, personal communication, December 11, 2009).

The recognition that a close collaboration, respect and understanding of each others' work as well as effective communication are of utmost importance to make husbandry programs a success.

Future, What is Next?

Many zoos and aquariums housing marine mammals have changed to larger, but not always necessarily species-specific and appropriate housing and husbandry management programs.

One of the main challenges in the future will be to continue to strive for the best environment and animal welfare and testing the status quo where needed. In conclusion, I would like to suggest some topics for further advances in marine mammal husbandry programs and for future research.

Marine mammal trainers use visual, auditory and other stimuli to elicit behaviors. More research is needed into the learning capabilities of marine mammals, how they discriminate between the different stimuli we use to elicit husbandry behaviors, what makes stimuli salient and which senses they prefer to use while discriminating. More insight is needed into the best application of behavior learning principles and marine mammal training, to enquire which techniques and principles are the most successful in creating a learning environment.

The manner and use of marine mammals for entertainment purposes merits in depth discussions on the ethics and content of marine mammals in shows and presentations. The way the animals are portrayed to the audience, the content and delivery of the story and the role of the animals in the shows should be examined. The marine mammal industry should monitor and standardize the educational content given to the public, further validating the educational value of marine mammal parks. More research is needed on the impact of marine mammals housed under human care on the millions of people visiting marine parks worldwide. Data are needed on the impact that the animals make as ambassadors for their species in the wild, changes in behavior of the public, success of conservation of marine mammal ecosystems and in a broader sense, conservation and respect of the natural world.

The data and results on the different topics mentioned above should preferably result in more publications of behavioral and husbandry studies in peer-reviewed journals.

Another important topic which needs attention is due to the working hours of marine mammal caretakers. Most of the time they are not on site to provide for

the animals therefore animals could learn to choose to forage, to spend time in a different location or social group, or to switch on a wave machine. A provision of semi-autonomous exhibits could provide more choice and control over their environment.

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