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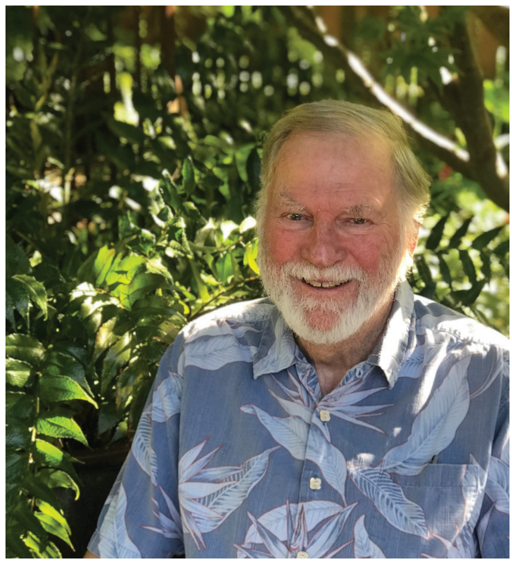
Historical Perspectives

A. Blair Irvine

(29 August 1941)

Blair Irvine had a relatively short career as a marine mammalogist, 1965 to 1980. Techniques for working with marine mammals were in the nascent stage then, and, consequently, a lack of experience did not prevent him from taking advantage as opportunities emerged. He trained dolphins and a killer whale for open sea release to determine if marine mammals might be of use to the U.S. Navy. Then, he trained a dolphin to attack sharks in Sarasota, Florida. Concurrently, with a high school kid named Randy Wells, later to be abetted by Michal Scott, he started the first study of a wild dolphin population, which is now in its 50th year, and he happened into the first government job as a manatee field biologist with the U.S. Fish and Wildlife Service. Then, in 1980, he changed careers, but he continued actively volunteering with the Sarasota Dolphin Research Program for 30+ more years. Along the way, he picked up an M.S. in Zoology, an MAPE in Exercise Physiology, and a Ph.D. in Community Health Education from the University of Oregon. His degrees led to a career developing National Institutes of Health-funded interventions to change health-related human behaviors and to improve skills to care for and communicate with persons with dementia.

Blair and his wife Barbara have resided in Eugene, Oregon, since 1983. She was an accomplished scientific illustrator, potter, fabric artist, and photographer. Their twin boys, Shawn and Ladd, the largest twins ever born in Florida at the time, still live in Oregon. Ladd is a marine mammalogist, working for the Oregon State University Marine Mammal Institute and now pursuing a Ph.D. He got his start cleaning freezers and as a minimum-wage gofer for Bruce Mate. Shawn is the Economic Development Director for the City of Independence.



The Accidental Marine Mammalogist

A. Blair Irvine

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In 1965, I was about to graduate from Pomona College. I was lamenting my approaching clueless entry into the real world, but a faculty member and friend set up a meeting for me with Kenneth Norris at his office at UCLA.

My first piece of luck was finding Ken in his office for the meeting, which he had forgotten. My next stroke of luck was his willingness to overlook how little I brought to the table as a marine scientist. After all, I was a Sociology major with no science background and completely ignorant about dolphins. The best I could offer in terms of a nautical background was having served as the captain on the 20,000 Leagues Under the Sea submarine ride at Disneyland. In any case, we got along, and he offered me an unpaid summer job if I would watch over a dolphin traveling via Navy cargo plane to Hawaii.

A few days before the trip, I visited the Point Mugu Naval Air Station (NAS) to see the dolphin, a bottlenose dolphin (*Tursiops truncatus*) named "Alice." While watching her surface to breathe, I asked a seaman, "What's that hole on her head?" He politely explained that it was called a blowhole, but I still remember that he looked at me like he couldn't believe I'd been to college. That's how naive and undereducated I was about dolphins.

For the plane ride to Hawaii, Alice was placed on foam mattresses in a large box and covered with a moistened sheet. I was to keep the sheet wet and tip her from one side to the other about every 30 minutes to prevent heat sores on her belly. Even naive as I was, I managed my simple duties during the 10-hour trip, ending at Sea Life Park without problems.

That summer, I worked on acoustic studies at Sea Life Park and in the wild. My job was mostly holding wires and moving equipment, but I also was part of the team that traveled offshore to study the acoustics of rough-tooth dolphins (*Steno bredanensis*) and to test the deep-diving capabilities of a trained *Steno*. The remarkable thing was not so much what I did, but the people I worked with. Bill Evans was a 40-something Ph.D. student under Ken Norris who conducted the acoustic studies. Evans went on to have a distinguished career studying cetaceans for the U.S. Navy, founded the Hubbs-Sea World Research Institute, and eventually chaired the U.S. Marine Mammal Commission (MMC) and headed the National Oceanic and Atmospheric Administration (NOAA). I also worked with Karen Pryor, a co-founder of Sea Life Park and the Oceanic Institute with her husband, Taylor ("Tap") Pryor. Karen became famous for her behavioral studies and animal training techniques, and served on the MMC. Robert Ballard, a dolphin trainer, later achieved fame as an undersea explorer and discoverer of the wreck of the HMS *Titanic*.

I also met Dr. Sam Ridgway, the marine mammal veterinarian at the Pt. Mugu NAS. He had flown to Hawaii to treat a dolphin who had swallowed a pool float and had stopped eating. To avoid a risky surgery, Sam hoped to remove the float manually with what he termed "the long-greased arm technique" (Ridgway, 2008). Tryouts were held to determine who had the longest, skinniest arm. Being 6'5" with lanky arms, I thought I had won the contest, but I was edged out by Tap Pryor whose arms were even longer and skinnier. Tap was successful in removing the float, and the dolphin started eating again. At the end of the summer, my skinny-arm audition with Sam Ridgway unexpectedly paid off, however. I had enrolled at San Diego State University to pursue a Master's degree in Biology when Sam called. He asked if I might be interested in working as a dolphin trainer to fill a sudden vacancy. The next morning, I drove to Pt. Mugu and landed the job.

I was immediately introduced to "Tuffy," the Navy's prize bottlenose dolphin. An amphibious Navy "duck" carried us out to Tuffy, who was in a pen in the Pacific Ocean, about 200 m offshore. The sea was rough enough to make the pen bob and bang against the side of the duck. Tuffy had been trained to work in the open ocean and to carry tools attached to his harness to SeaLab divers living on the bottom at 60 m. This demonstration of a dolphin's potential to work with divers gained international attention for Tuffy.

But Tuffy also had a reputation for being feisty. He had been purchased by the Navy at a low cost because, while he was well trained, he was considered incorrigible and untrainable. At the Marine Bioscience Facility (MBF), he was tamed by Debbie Duffield, at the time a technical assistant to Sam Ridgway waiting to get into grad school and now a respected marine mammal geneticist. On the day of my visit, his aggressiveness was on full display. Wally Ross, the trainer whom I was to replace, was doing his last ocean training session with Tuffy. Wally had trained circus animals and would go on to train animals for the movies, but this last session was more of a brawl. Tuffy refused to respond to commands and then proceeded to bite Wally, who immediately hit him on the rostrum. Then, Tuffy swam partially out of the water, apparently attempting to bite Wally's face. Wally successfully fended Tuffy off with a forearm, but that ended the session, and we returned to shore. I can't imagine a more intimidating introduction to the dolphin I was supposed to train.

Training for the Navy

The MBF was located on a spit of land at the south end of the Pt. Mugu NAS (Figure 1). It consisted of several dolphin pools, a laboratory building, and several trailers and cargo containers. Steel pontoons with more dolphin pens extended into Pt. Mugu Lagoon, which emptied into the Pacific Ocean, about 400 m southwest of the facility. Forrest G. ("Woody") Wood, the former curator of Marineland of Florida, was manager of the facility. Sam Ridgway was in charge of animal health and research. When I arrived, staff consisted of fewer than 10 civilians, a few sailors who maintained the facility, and up to three Navy petty officers/divers who assisted with animal training and underwater activities.

Sam claims that Bill Evans said I could train dolphins, but, in fact, my only dolphin training experience consisted of watching dolphins being trained the previous summer in Hawaii and witnessing Wally's battle with Tuffy. When I started

Figure 1. Marine Bioscience Facility, Naval Air Station, Pt. Mugu, California, in 1965. Steel pontoon pens extend into Pt. Mugu Lagoon. The inlet for boat travel into the Pacific Ocean (*bottom right*) is out of the photo to the right. (Photo courtesy of U.S. Navy)

work at the facility, nobody quite knew what to do with me because training a new trainer was a new experience for them. I was given some books to read about how to train pigeons and pigs to perform. I don't remember what the pigs did, but Sam developed an enduring affinity for pigs that eventually extended to founding a series of seminars called the Scholar's Wine-Imbibing Nocturnal Enclave or SWINE.

Several dolphin trainers worked at the MBF, but they were focused on their own projects. Among them, physicist C. Scott Johnson was conducting the first underwater hearing threshold study of a dolphin (Johnson, 1966, 1968). His experiments were entirely automated, which for the time was unheard of. An acoustic signal notified the dolphin to station between two speakers and listen for randomly delivered sounds. Fish rewards were provided by an automatic feeder. Scott was the first to train a dolphin to station for veterinary examination and blood draws (Ridgway, 2008)—medical behaviors that are now standard practice with captive cetaceans.

Scott was friendly, but he didn't have much time to teach the new kid to train, much less the nuances needed to work with, an experienced, and occasionally aggressive, dolphin like Tuffy. Scott did take me out for a beer after work and gave me the grounding I needed to work with Tuffy and beyond. Scott's premise was simple. Tuffy was experienced and had a repertoire of trained behaviors, but he also could act like a moody, spoiled child. Scott suggested I be consistent and positive with Tuffy, rewarding desired behaviors and disciplining undesirable behaviors or refusals only with a timeout (e.g., walk or turn away for a minute or so). Timeouts are pretty standard training and parenting tools now, but back then it was a pretty new technique. I've always been indebted to Scott for taking the time that evening. His advice was memorable, and it gave my ragged confidence a boost.

My first few attempts to hand-feed Tuffy, with his ~90 pointy teeth, were tentative, but soon we got along. He taught me the tricks he already knew, like jumping and tail walking, and I figured out how to link them to commands so he'd do them when I wanted. Based largely on Scott's advice, my rather timid touches around Tuffy's head expanded into full body rubdowns as part of each training session. He seemed to enjoy it and so did I. Much time was spent reinforcing his reliability to go through gates on command, which was important if I wanted him to come back into his pen at the end of a training session in the ocean.

I also discovered that Tuffy had a sense of humor. Tuffy resided in a rectangular onshore tank, bordered on two sides by a sidewalk. Swimming rapidly along the long side of the tank with his head out of the water, he could create a wave that when it reached the end of the tank, splashed onto the sidewalk. One day, Sam Ridgway accompanied a VIP from Washington, DC, toward the narrow end of the tank. Tuffy saw them coming and timed his swimming so that the wave crashed into the wall and doused the VIP. Sam, who had held back, was unscathed. The VIP, in his business suit, was clearly startled, but he started laughing when Sam, expressing surprise, said that Tuffy was welcoming him. I've always suspected that Sam was an accomplice in Tuffy's ambush.

When Tuffy was reliably responding to commands in the rectangular tank, he was moved to the pontoon pens in Pt. Mugu Lagoon (Figure 1). There, we confirmed his trained behaviors inside and outside of the pontoon structure, and near motorboats (Figure 2). Tuffy learned to follow a boat at speeds up to about 15 kph. Then he was ready to move back into the ocean, and a new pen was constructed and anchored offshore (Figure 3) where I had first seen Tuffy attack trainer Wally Ross.

With the MBF gearing up to train multiple dolphins in the ocean, the decision was made to train from motorboats. The downside of using a boat was that to get to the ocean pen by boat from the MBF required transiting the mouth of Pt. Mugu Lagoon outlet to the Pacific Ocean. Getting in and out required the boater to navigate a narrow, ever-changing tidal channel to the ocean, then pause in the shallows while waiting until a gap in the 1 to 2 m high waves allowed a quick trip through the surf. The trip out was often exciting and sometimes wet and jarring. The tidal flow and murky water routinely made the shallows hard to avoid, however, resulting in beat-up boat engines. At times, we kept a boat mechanic working full time to keep our boats operational so we could get offshore.

Once out at Tuffy's ocean pen, my job was to maintain his current behaviors and prepare for new assignments. I was SCUBA qualified, and I wanted to do underwater training in person. First, though, I had to be checked out by Navy diver Marty Conboy, who had been at the MBF since the beginning. I didn't tell him that I'd never been below 9 m or in poor water visibility. Our first dive to 24 m in water visibility of about 1 m was uneventful, however, so I was assumed to be capable enough for future dives to train Tuffy.

Working with divers was a priority, and I began doing underwater training, too. Tuffy wore a harness for work at the Navy's underwater habitat, SeaLab II. However, they never fit well on his flexible body, so we soon abandoned harnesses completely. Instead, we attached any objects for Tuffy to carry on 20 cm × 1 cm copper rings. To add diversity to his training, I had him retrieve a copper ring thrown overboard at depths of 24 to 36 m. Tuffy never failed to find a ring. Given the usually turbid water conditions, he seemed to be demonstrating the use of sonar for retrieving objects.

Tuffy was taught to carry the rings to an electronic pinger held by a diver. It was always fun to call Tuffy down to the ocean floor with the pinger. Water visibility was often 1 to 3 m, and we never could anticipate his direction of approach. I usually heard his sonar first, especially if he came from behind at head level. He usually allowed himself to be stroked for 10 to 20 seconds before

Figure 2. The author watches Tuffy jump on command during boat training in Pt. Mugu Lagoon. This trick was one of a repertoire of behaviors used to break up boat-following practice. A healed shark bite scar is visible on Tuffy's side. It occurred before he was taken from the wild. (Photo courtesy of U.S. Navy)

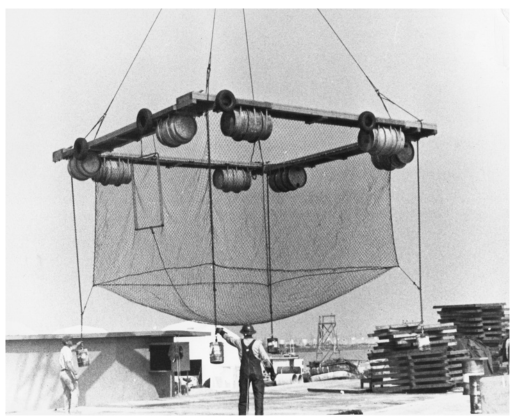

Figure 3. A dolphin ocean pen being readied to be anchored in the ocean. Narrow walkways are supported by buoyant barrels. The gate, for underwater entry and egress, is visible on the far side. (Photo courtesy of U.S. Navy)

he returned to the surface, sometimes with a diver-supplied package attached to a copper ring. He was often submerged for 2 to 4 minutes.

Personally, I was in hog heaven. I was training a dolphin in the open ocean (Irvine, 1970b). Seven days a week, when Tuffy was in the ocean pen, I had to crash through waves in a motor boat to get out to him, and then get back past the waves and shallows into Pt. Mugu Lagoon afterwards. What an adventure! I had little direct supervision. With Wally gone, as soon as I started ocean training, I became the expert. I had to organize the training plan, diver support, or other help, and adapt everything as necessary to tidal conditions at the Pt. Mugu Lagoon inlet and sea conditions around the ocean pen. During the rest of the work day, I was preparing new dolphins to work offshore, and building or waterproofing equipment for the work offshore.

Almost immediately, we started preparing for SeaLab III, where divers would live for several weeks at a depth of 183 m. We couldn't train Tuffy at such an extreme depth, but a small artificial habitat was placed at a depth of 24 m to reacclimate him to working with divers around a structure. Tuffy quickly acclimated, working with divers nearby (Figure 4); and he was even willing to stick his head inside the habitat to accept fish. Later, some of the SeaLab III divers came to the MBF to dive with Tuffy, who carried dummy objects to them on the bottom. It was interesting to watch these intelligent and brave men, who were preparing to live at an extreme depth, adapt to a dolphin underwater. Accepting the ring from the dolphin seemed to intimidate them at first, but they quickly adjusted. Sadly, one of the divers later died during SeaLab training, and the entire project was scrubbed.

Tuffy's training was expanded to include extended boat-following. When traveling behind the boat, he appeared to expend little energy, surfing in the wake only about 1 m away from the spinning engine propeller. It took me many hours of watching this behavior to accept that he wouldn't drift into the propeller and be injured. Subsequently, Tuffy traveled 24 km each way on a prolonged boat-following run near Panama City, Florida.

An initially nerve-racking sidelight of the boat-following run in Florida occurred when Tuffy suddenly veered out of the wake and approached a group of wild bottlenose dolphins, about 100 m abeam of the boat. Since he had been originally captured in that region, we were concerned he might go back to the wild. Fortunately, he was out of sight only briefly, and then he came quickly back to the boat and assumed his position near the motor as we traveled on. After that, I saw groups of wild dolphins 30 to 100 m off our beam, and I

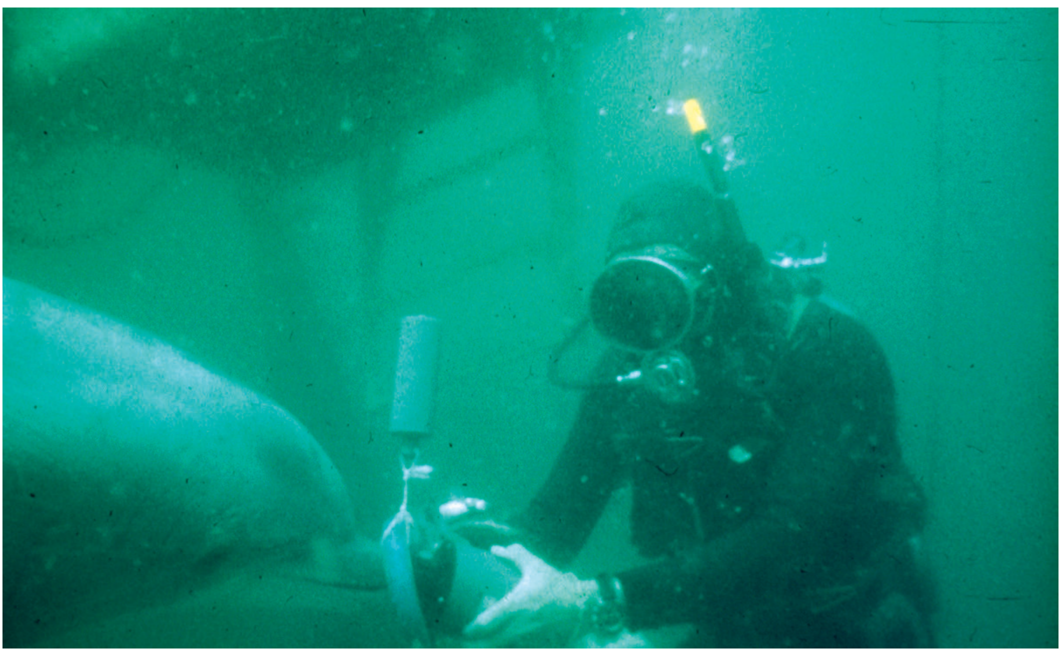

Figure 4. Tuffy touches an acoustic pinger held by a diver in front of the SeaLab training habitat (background). Visible on Tuffy's rostrum is a ring with a buoyant object attached by white line, which he delivered to the diver. Tuffy was rewarded with a fish from a bag barely visible below the diver's wrist. (Photo courtesy of U.S. Navy)

watched Tuffy closely. Several times, he quickly turned his head in the direction of the dolphins, but he did not again leave the wake. Because the boat wake and turbid water probably precluded seeing the other dolphins, it thus appeared that even next to the noise of the outboard engine, Tuffy was able to hear them.

Starting in 1966, the MBF added more dolphins and trainers, seeking to both expand our capabilities for open ocean work and to verify that it wasn't just Tuffy who could be worked reliably in the open ocean. That brought on new trainers. Some, like John Hall and my brother Rock Irvine, were as inexperienced as I was initially; and others, like the recently retired Navy Chief Bill Scronce, had helped when the MBF was first established, and Don McSheehy had worked with dolphins previously. John Hall (1970) trained a Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) to work offshore, but after a few months, it suddenly disappeared during training, possibly joining a large herd of "Lags" traveling offshore. The MBF also added an Administrative Assistant, Steve Leatherwood, an English major who would go on to become an accomplished scientist, conservation writer, and editor (Leatherwood & Reeves, 1983; Leatherwood et al., 1983) before his untimely death from cancer in 1997. Steve arrived as an avowed English major with no aspirations to be a trainer, but he did become an avid diver during his time with us.

One of my assignments was to continue the deep dive experiments for Sam Ridgway, which started when Wally Ross trained Tuffy to go to depths of 76 m. When I took over, the goal was to see if Tuffy could reach 152 m. Within weeks, Tuffy dove to the end of the cable with little hesitation. His only obvious compensation as the depth increased was that just before diving, he took several quick breaths, much as a competitive swimmer might do just before the starting gun sounds. Later, Bill Scronce trained Tuffy to dive to 297 m and to exhale into an inverted funnel for expired breath analysis at the end of dives (Ridgway et al., 1969).

During training exercises, the Navy shoots or drops objects into the water, such as torpedos and mines that sink to the ocean bottom. As practical, this hardware is recovered for re-use. If the gear is classified, recovery is considered mandatory, requiring divers to search and ships to standby until the recovery is accomplished. Even with a directional pinger detector to home in on pinger-marked hardware, diver searches are time consuming, inefficient, and increasingly dangerous as depth increases.

In 1965, before I arrived, Tuffy assisted with recovery of a Regulus II rocket cradle, valued at $4,700, that fell into the sea after launch. By homing in on a pinger attached to the cradle and diving repeatedly nearby, he led divers close to where it fell, leading to its recovery (Wood, 1973).

The question posed to me was whether Tuffy could locate a top secret ASROC (anti-submarine rocket) shot from a Navy ship some kilometers away that ended up in about 60 m of water? If Tuffy could find and mark the ASROC, recovery time for the Navy divers might be reduced, thus demonstrating potential applications for marine mammals.

We were confident that we could teach Tuffy to find an object on the bottom with a pinger attached. A larger challenge was how we on the surface would know he had accomplished the task. We decided Tuffy would need to drop a weight from which a float, attached by a line to the weight, would rise to the surface to mark the location. Navy divers could then follow the line from the surface to the weight on the ocean floor. We had a few months to train Tuffy to perform the behavior while at the same time developing the marker system for him to carry to drop on the ASROC.

As expected, Tuffy quickly learned to drop copper rings onto dummy rockets (trashcans welded end to end) with attached pingers set at the frequency to be used on the ASROC. Tuffy showed no problems carrying the copper rings distances of 100 to 200 m.

Development of the marker system was problematic. After multiple failed attempts, our final choice, dubbed a marker-wheel, was a handcrafted 25-cm-diameter buoyant, hard-plastic, doughnut-shaped ring from which hung a lead weight. Light line was wrapped around a groove in the circumference of the ring. When Tuffy dropped the ring off his rostrum, the weight went to the bottom, and the ring floated to the surface, spinning as it unspooled line from around its circumference.

The ASROC test occurred off San Nicolas Island, a Navy-owned island 112.6 km off the coast of Southern California. Days prior to the test, our training boat was brought to the island, and an ocean pen was constructed and anchored several kilometers from the target area by Mo Wintermantle. The bottom was rocky with dense kelp beds, and the ocean swells were significantly greater than we experienced when practicing on the sandy bottom off Pt. Mugu. Training activities each day included "hide-and-go-seek" with a copper ring. I held Tuffy's head out of the water so he wouldn't be cued while the ring was thrown and allowed to sink. When given the search command, he sometimes dove in the wrong direction, but after appearing to search broadly, he soon oriented in the correct direction and always returned with the ring at depths to 70 m.

The ASROC, fired from a Navy destroyer about 10 km off the island, went airborne and then it hit the surface and sank. I gave Tuffy copper rings and followed him to where he dove and then surfaced. Assuming we were near the right location, I then gave Tuffy several marker-wheels, rewarding him each time he surfaced without the marker. We waited anxiously for the marker-wheels to unspool to "officially" mark the location of the ASROC but none appeared. How disappointing! That night, though, we heard that our copper rings and the anchors and line from our marker-wheels were draped on the ASROC when Navy divers found it. Our marker-wheels were apparently not buoyant enough to reach the surface through strong ocean currents that day. Later that year, we repeated an ASROC test in the same area. This time the marker-wheels did reach the surface and clustered in a small area, indicating that Tuffy again did his job.

Soon, we were presented with another demonstration opportunity. As part of a coordinated fleet-training operation, Navy aircraft routinely dropped drill-mines with pingers attached at a 15 to 20 m depth near Santa Rosa Island off Santa Barbara, California. Then, Navy mine sweepers conducted training operations to locate the mines as they might do in a combat situation. Afterwards, the mine sweeper and support ships with dive teams stayed on site to recover the mines. The process for divers to locate the mines usually took at least 60 minutes per mine. Our task was to have Tuffy expedite the mine-recovery process by precisely marking mines so the divers could descend directly to them without searching for a pinger.

We arrived on site at about 1600 h, and an hour later, we went to work. The water was very rough, with winds blowing at about 20 to 30 kts, making boat handling difficult. In fact, once we swamped as we stopped to give Tuffy a marker-wheel and were in danger of sinking, so we had to run the self-bailing boat downwind at speed (while bailing madly). Tuffy must have thought we were crazy as he tried to follow along until we finally had emptied the boat of enough water to return to the area.

During the remaining hours of the day, Tuffy marked a total of nine drill-mines, while the dive teams marked nine others. The MBF subsequently received a letter of appreciation from an Admiral crediting Tuffy with a higher marking rate than the teams of divers, thus reducing the recovery time by half (Wood, 1973). This was indeed high praise and a considerable cost savings for the Navy since the recovery fleet standing by consisted of four mine sweepers and a support vessel.

The Navy subsequently developed far more efficient solutions to recover pingered objects on the bottom. Depending on the depth and circumstances, either bottlenose dolphins or California sea lions (*Zalophus californianus*) are typically used. "Grabbers," carried by the animal, will attach to the underwater object, allowing it to be hauled to the surface without requiring divers. Sea lions have excellent directional hearing to home in on pingers, and they are more easily transported than dolphins. Sea lions can be housed in crates and maintained on ships, whereas dolphins require sea pens and more complicated transport systems.

On Monday, January 20, 1969, I arrived at the ocean pen to begin a training session, but Tuffy and a dolphin named "Pegasus" were gone, and the gate was open. We mounted immediate boat searches to the north and south. The following Wednesday afternoon, we were searching about 55 km north along the coast. We had not seen our dolphins, but a Navy helicopter appeared and circled about a kilometer farther offshore of our position. As we moved that way, Tuffy appeared in our wake. His behavior appeared normal. He readily performed his usual training behaviors, and he was amply rewarded from a bucket of fish we had with us.

But we had a dilemma. We could not return to the MBF before dark at boat-following speeds with Tuffy in the wake. The helicopter was short of fuel and had to leave, so hoisting Tuffy up was not an option. Even if we could lift him into the boat, there was not enough room for a dolphin in a stretcher. And leaving him there and hoping to find him the next day was too risky. So, the best option was to put Tuffy into a stretcher and transport him to Pt. Mugu in a larger boat, which was called in by the helicopter.

The good news was that I was wearing a wetsuit, and Tuffy had been trained to let me handle him in the water. The bad news was that Tuffy was usually evasive and sometimes aggressive when we tried to put him in a stretcher. Since we were in deep water offshore, if he even suspected a stretcher was in his near-future, I doubted that he would let us get near him.

About 2 hours later, as the boat approached, the rescue plan was hatched. I was to get in the water with Tuffy and, at some point, I would wrap my arms around him and subdue him if he struggled. Then, we'd put the stretcher in the water, put Tuffy in it, and hoist him onto the NAS boat for the trip home. I expected him to resist violently, but my hope was that eventually he would stop. Never having tried to subdue a struggling dolphin in deep water, it seemed to be a tenuous plan, but I saw no alternative.

First, I gave Tuffy a rubdown in the water. I remember thinking as I then reached to lock my arms around him that I better not allow myself to be bucked off or we were screwed. So, I grabbed and hung on. It seemed akin to riding a bucking rodeo bull but in the ocean. Tuffy thrashed and tried to buck me off. He dove and twisted, and he tried to jump, but I hung on like a big rag doll. Finally, he stopped. We were able to put him in a stretcher, and he and I were hoisted onto the boat. We then headed back to a media-rich welcome home at the MBF. The return of the famous missing Navy dolphin made headlines.

But the dolphin Pegasus was still lost, and while we continued our search, a new threat became apparent. On January 28, 1969, an offshore oil well blew out in the Santa Barbara Channel, starting the then-largest oil spill in U.S. history. The consequences if our dolphin encountered floating oil were uncertain but probably grim. Then, on February 3, a dolphin was spotted in Santa Barbara Harbor about 25 km north of Tuffy's recapture site. A rescue team quickly headed north, arriving after dark. We deployed an inflatable dolphin pen (Irvine, 1970a) in a boat slip, and Pegasus swam through the gate on command. She was on her way home within the hour. The next day, the harbor where Pegasus was reacquired was covered with 2.5 to 7.6 cm of heavy crude oil.

Then, it was on to the next challenge. The Navy was concerned that hostile swimmers could potentially inflict damage and cost human lives on ships anchored in harbors around the world. Dolphins had the potential to find intruders in the water because, even moving slowly, swimmers cause ripples or bubbles, which are acoustically loud to a dolphin's sensitive hearing. My assignment was to try to demonstrate a dolphin's capabilities to detect swimmers.

I had been acclimating an inexperienced dolphin named "Redeye" in the onshore tanks for several months. This was to be his first project and first time away from the cement pools. We moved him into the pontoon pens from which he quickly escaped into Pt. Mugu Lagoon. Apparently, there were gaping holes in the torpedo net fencing, which Tuffy and other dolphins had ignored for years. Finding Redeyde and coaxing him back was challenging (Irvine, 1971), but once back, his responses to commands quickly returned to normal, so the swimmer defense training commenced.

Essentially, Redeye swam a sentry route. If he detected a swimmer while either coming or going to the terminus, Redeye returned and pushed a "detection paddle." A rubber cup was then fitted on his rostrum, and he took it to touch the swimmer, thus pinpointing the intruder's location. As training progressed and the sentry route was gradually extended, the swimmers used their imagination to try and sneak by Redeye, but they always failed.

When Redeye's proficiency was established in Pt. Mugu Lagoon, we transported him by air to a Navy facility in Florida for a demonstration. He was to "defend" a small pier after dark. The pier was occupied by Navy brass (lots of gold braid). The intruders were Navy Seals. All incursions by the swimmers were unsuccessful. Redeye's demonstration led to the development of the Navy's Mark 6 Force Protection system, which is currently used to defend Navy moorings and harbors in different parts of the world.

Next up for me was a very different challenge. Might a killer whale (*Orcinus orca*) be trained for open sea release, for physiological research, and potentially to help Navy projects? In October 1968, two killer whales were suddenly made available for Navy purchase by the Seattle Aquarium. Remember, this was 1968. Back then, even getting in the water with a killer whale, much less training one, was unusual, and their reputation was fearsome.

I accompanied Sam Ridgway to the capture site and helped capture two subadult males. We arrived on the scene where 8 to 12 killer whales were enclosed by steel torpedo nets, partitioned into several sections, each containing animals. Our two individuals were transferred to a large 1.5-m-deep tank at Seattle Aquarium. Sam and Woody borrowed heavy steel frameworks, canvas liners, and stretchers. We put the setup together in 10 hours; and the next day, the whales were flown to the MBF aboard a National Guard C-141 Star Lifter cargo jet.

During the 6-hour flight, the two killer whales, suspended in stretchers in the canvas-lined steel transport frameworks, were quiet, and we kept them moist with sprayers and buckets of water. While the landing at Pt. Mugu NAS was without incident aeronautically, it did cause shouts of anger from the flight crew chief when, upon touchdown, the jets were reversed to slow the plane down on the runway. The sudden loss of momentum caused gallons of urine- and feces-impregnated water to rush forward and splash over the canvas walls of the transport frameworks. Air crews don't like water splashed on their airplane interiors because of the corrosion threat. Stinky urine and feces in the water from our whales probably increased their outrage. The air crew had been friendly until we landed. After we left the plane, they immediately turned and headed home, with the clean-up of our liquid mess no doubt keeping them busy.

Initially, both killer whales were held in the 15-m-diameter concrete tank. Being only 2.4 m deep, their movements were constrained. One whale, named "Ahab," was trained in the tank by John Hall, and the other, "Ishmael," was who I was assigned to train for the open ocean in Pt. Mugu Lagoon.

A 24 m × 15 m pen with 3-m-deep net walls was prepared using floating dock sections in a remote part of Pt. Mugu Lagoon in 3.6 m of water. The pen was about 25 m offshore of a harbor seal (*Phoca vitulina*) haulout of up to 40 animals. Ishmael was from the Southern resident killer whale population in the Puget Sound, which feeds on salmon and not marine mammals (Marine Mammal Commission [MMC], 2020). I watched carefully, and I noticed no behavioral changes by Ishmael as the seals transited within 20 m of the pen.

Having only trained dolphins, and being unsure how aggressive Ishmael might be, I was very cautious at first. Working from a 1.2 m × 2.4 m raft, I gradually acclimated him to touches inside his mouth, including his teeth and tongue. My rationale was that if he was used to me touching inside his mouth, he might be less likely to accidentally bite me. I'm not sure I agree with that logic now.

Ishmael quickly acclimated to training and food rewards for required behaviors. Having said that, he always seemed to hesitate briefly when given a command. I wasn't sure if he was "thinking" about how to respond or if it was just a species or individual trait to react more slowly compared to the other dolphins I had trained. In any case, within months, the training regime included gate training and following a small motor boat inside the pen. About 6 months after first being moved into the pen, Ishmael was released into Pt. Mugu Lagoon. He followed the small boat (Figure 5) and went in and out of his pen through a gate on command. He potentially could have escaped to the open sea via the lagoon mouth, but he remained with the boat while away from his pen.

While the training went as expected, I never quite trusted Ishmael. On two occasions, I had donned a wetsuit and entered the water with him. When I slid into the water off the side of the training raft, in the corner next to the net, he started ominous circling, coming within about 30 cm of the raft on each pass. I might have been crushed against the raft if I ventured out. He continued circling until I climbed onto the raft. Then he returned to his usual stationing position in front of the raft as if in preparation for a training session. About 2 weeks later, I entered the water again with him and his responses were identical, so I gave up trying.

Figure 5. The author leading Ishmael, the killer whale (*Orcinus orca*), during boat training in Pt. Mugu Lagoon (Photo courtesy of U.S. Navy)

The next logical step for Ishmael would have been to be trained in the ocean. But I was hesitant, and I discouraged the move to a large steel pontoon pen already anchored offshore. I was concerned that we didn't know how he'd react to other trained dolphins in the area or to divers. And what would happen if wild killer whales were to pass within acoustic range?

Other issues influencing my reticence to move Ishmael to the ocean involved upcoming transitions. The MBF was to close the following year, with personnel and assets moving to San Diego or Hawaii. The killer whales would resume training in Hawaii, and the Navy encouraged me to follow. But I knew I didn't aspire to a career training marine mammals, and I was conflicted about the Vietnam War. Being newly married to Barbara Stolen, Sam Ridgway's scientific illustrator, I was ready for new adventures, possibly involving travel and grad school. And then came a new opportunity to train a dolphin to ward off sharks in Sarasota, Florida. It was just intriguing enough to point me in that direction. And so off we went, Barbara and I, during the final days of 1969.

Sharks and Dolphins

On January 2, 1970, I started working for the dolphin–shark project at Mote Marine Laboratory (MML) in Sarasota, Florida (Figure 6). Perry W. Gilbert, the MML Laboratory Director, was a pioneer of the live capture and study of sharks. Perry had an Office of Naval Research grant to determine if dolphins could be trained to attack or ward off sharks, which were a potential threat to Navy divers. If preliminary studies in onshore pools supported the project's potential, a subsequent grant was planned for further study in the open sea.

Located at the extreme south end of Siesta Key, a barrier island west of Sarasota, MML was a few hundred meters from the Gulf of Mexico. Live sharks, up to about 4 m in length, were caught offshore and taken by boat to MML, where they were placed in a 25-m-diameter circular channel (the "racetrack"), which allowed them to swim constantly, maintaining a flow of seawater across their gills. The channel was connected by a double-gated flume to a 15-m-diameter, 2-m-deep circular tank. A 3-m-high platform was located over the flume for observation and filming of activities in both pools.

Figure 6. Mote Marine Laboratory in Sarasota, Florida, in 1970. The small lagoon seen above the circular tank was accessible by boats, which brought in newly captured sharks from the nearby Gulf of Mexico. The lab was later moved to City Island near downtown Sarasota, and this facility was destroyed by shifting sand and encroaching seas.

Figure 7. High school volunteer Randy Wells records dolphin–shark activities from the observation platform overlooking the circular tank

Phase I of our research studied interactions between untrained dolphins and different shark species. Popular accounts suggested dolphin–shark interactions are often hostile (Wood et al., 1970), but experimental research was lacking. Two adult bottlenose dolphins were captured and transported to the circular pool. Different species of shark, 1.8 to 2.7 m long, including sandbar sharks (*Carcharhinus milberti*), bull sharks (*Carcharhinus leucas*), nurse sharks (*Ginglymostoma cirratum*), and lemon sharks (*Negaprion brevirostris*) were individually guided into the pool with the dolphins. The dolphin–shark interactions were filmed from the observation platform and dolphin sound emissions were recorded, after which the shark was guided back into the circular channel. We spent hours cloistered in a small trailer watching the film and listening to dolphin sound emissions. It was intensely boring work. Nothing ever happened. The sharks generally swam around the tank perimeter, and the dolphins generally stayed near the middle. Neither species obviously tried to interact with the other (Gilbert et al., 1970). In sum, our findings suggested that sharks and dolphins will not necessarily attack each other whenever they come into contact.

Randy Wells deserves a special introduction here because of his future role in the development of dolphin field research and marine mammalogy. As Barbara and I were buying a house, the realtor's partner, Jack Wells, overheard a conversation about my upcoming work at MML. He mentioned that his son, Randy, a high school junior, had tried unsuccessfully to get a volunteer job at MML. Would I be willing to talk with him and consider him as an assistant? I agreed to interview him. Trying to be gently discouraging, I agreed Randy could do the scut work jobs of cutting up fish for dolphin food and cleaning dirty buckets. To my surprise, he showed up ready and willing to work. Small in stature, quiet, and wearing thick glasses (Figure 7), he initially professed to be interested in sharks. Since he showed up regularly, I drafted him to help with the dolphin–shark interaction study and analysis. Even as boring as that was, he kept coming back, and soon he gained our respect.

One weekend day, as I was feeding the dolphins, Randy showed up in an outboard boat dragging a dead dolphin. He and a friend had watched the dolphin die, so he brought it to MML. It had white crusty markings, reminiscent of cauliflower, on the tail flukes, extending onto the stock (peduncle). Even though I had never seen one performed, I did a necropsy with a butcher knife from the MML kitchen. I didn't have a clue what I was looking at. My goal was only to take enough meat off so that the bugs would render the rest and we'd end up with a skeleton, eventually. I did have enough sense, however, to cut off samples of the white crusty tissue, and Randy took photos. I then sent the samples off to Sam Ridgway at Pt. Mugu with a note about the sex, length measurement, and the behaviors Randy saw. And then I forgot about it. About a year later, I was surprised when Sam sent me a copy of an article that was published about the white crusty material on the dead dolphin (Migaki et al., 1971). This was the first record of Lobo's disease, a keloidal blastomycosis (now known as *Paracoccidioidomycosis ceti*), which had previously only been reported in Central and South America. This was the first case in a mammal other than humans. The problem was that I apparently was nonspecific about who made the find and saw the dolphin's dying behaviors, so I was a co-author when it should have been Randy. I still feel bad about that.

Phase II of the research was to train a dolphin to ward off sharks. A local fisherman came to MML in his boat saying he had a dolphin in his monofilament net and that we could have it if we would come and get it. Quickly gathering every willing person at MML, we went with the fisherman who had his lightweight monofilament mullet net encircling a large dolphin nearby. We formed a human chain to herd the dolphin into a strong shark-herding net we had brought, and, after a brief struggle, the dolphin calmed down and we were able to put the animal into the flooded bottom of a Boston Whaler and another boat towed it back to MML. For some reason, I had Randy riding in the boat near the tail of the dolphin while I was near the head. During the tow, the dolphin thrashed, and Randy went flying overboard. Randy still holds me accountable for that dunking.

Once back at MML, the 200-kg, 2.6-m-long male dolphin, named "Simo," was released into the circular pool. One of his behaviors was unusual. While most captive dolphins in my experience tended to hang near the surface of the water when not moving, Simo preferred to lay on the bottom. Over a period of weeks, Simo learned many of the behaviors I taught dolphins at Pt. Mugu, but he always refused to breach out of the water. Simo also learned to hit progressively larger dead sharks and then to hit dead sharks up to 2.5 m in length being towed around the pool (Figure 8). We varied the species of the dead sharks, but neither species nor size seemed to bother Simo.

Live sandbar sharks, nurse sharks, and lemon sharks up to 2.8 m long were then individually introduced (Irvine et al., 1973). Simo butted each of them on command, and he showed the capability to force a shark out of the pool by rapidly approaching from the side on a collision course as it passed the open flume gate. Live bull sharks, however, caused markedly different behaviors. Shortly after entry of a 1.8-m male bull shark, Simo, who was resting on the bottom, oriented toward the shark from a distance of 4.5 to 7.5 m, and he emitted four short, high-intensity echolocation pulses. He then appeared highly agitated, swimming rapidly around the tank and breaching. Even though the shark soon exited the pool without attempting to interact, Simo refused to

Figure 8. Simo hits a moving dead shark on command. The shark was being towed by the line attached to its nose.

respond to trained commands. Five days of training with dead sharks and then a live sand bar shark were required to re-establish his trained butting behavior. On the last day of scheduled training, a 2- to 2.5-m female bull shark was introduced. Quickly appearing agitated, Simo followed the shark, emitting uncharacteristic high-intensity barks, chirps, and echolocation pulses from close range. As happened after exposure to the other bull shark, Simo failed to respond to any training commands, even after the shark exited the tank without apparent aggressive behaviors.

Simo appeared to exhibit species recognition and negative species-specific responses to the bull sharks. Watching from above and listening to his sound emissions via a hydrophone, my impression was that he reacted behaviorally to the first bull shark only after the first burst of sonar pulses. Might he have identified the shark species acoustically? Size of the bull sharks was probably not a factor because the first bull shark was similar in size to a live sandbar shark he butted earlier the same day. Bull sharks, along with tiger sharks (*Galeocerdo cuvieri*) and dusky sharks (*Carcharhinus obscurus*), have been found with dolphin parts in their stomachs (Wood et al., 1970; Irvine et al., 1973; Wilkinson et al., 2017). Perhaps Simo recognized a potential predator. Other shark species used in this research were not commonly found with dolphin parts in their stomachs locally and, thus, may have constituted less of a threat.

The day after the bull shark encounters, Simo was tagged and released into the lagoon at MML, and we followed him by boat to be sure he didn't run aground in the narrow channels winding toward the Gulf of Mexico. He proceeded slowly, mostly on the surface. When he rounded the last bend in the channel and the waves of the Gulf were visible, he speeded up. Moving straight into the Gulf, he disappeared briefly; and then Simo, the dolphin who refused to be trained to breach, came out of the water in three consecutive monster leaps. After the last leap, he quickly disappeared in the waves.

Tagging Dolphins

While we were conducting the shark studies, I had the opportunity to chat with Dr. Jesse White, the marine mammal veterinarian at Miami Seaquarium who had dropped by MML offering to consult on health issues. During the visit, I walked with him to the beach, and we watched a bottlenose dolphin swim by close to shore. We discussed the lack of data about dolphin movements or home range, and we talked about the idea of somehow tagging wild dolphins for research. Finding funding to capture dolphins for research, however, seemed impractical as did the chances of seeing the tags afterwards.

But then opportunity intervened. I became acquainted with a local dolphin collector, Robert Corbin, who regularly caught and sold wild dolphins. He would encircle a group of dolphins with a long net, take his preferred animal, and then release the rest of the group. After hearing of my interest in tagging, he agreed that if I'd act as a crew member, he'd let me come along and tag the dolphins that he was about to release.

At about this same time, my old friend Bill Evans was tagging dolphins on the West Coast. They were putting on highly visible circular plastic button tags on dolphins, bolted through the dorsal fin, and they were experimenting with radio tags. They also were evaluating the use of "freeze brands," super-cooled copper branding irons that left a visible mark. When hearing of my interest in the movements and home range of local dolphins, Bill loaned me button tags, and later a set of freeze-brand numerals to try out on dolphins in Sarasota (Evans et al., 1972).

Soon, Robert Corbin contacted me to go out with him to catch dolphins. During the trip, he caught a dolphin he wanted, put it aboard his boat, and then I had my chance to tag the other dolphins scheduled for release. I used a large button tag (Figure 9) and took a photo for release in the local newspaper, but no sightings were reported. From then on, I was essentially on-call when Robert wanted to catch dolphins. After all, I had long arms and I worked for free.

Just before the third trip, I was at Robert's house before dawn, ready to go out. There was a knock at the front door, and I answered it since I was nearest. There stood Randy Wells, uninvited. He wanted to go tag dolphins, too. It was a school day, and, briefly, I had second thoughts about whether I might be abetting truancy, but he became part of the team. We went out with Robert on 20 successful trips where we tagged a total of 30 dolphins, and we went on multiple other trips when no dolphins were captured because Robert didn't see any that he could sell.

We subsequently learned that the round button tags (Figure 9), which Evans et al. (1972) reported seeing on pelagic dolphins up to 2 years after tagging, were shed by the *T. truncatus* in Sarasota soon after the animals were released from the net. The tags were subsequently redesigned and strengthened multiple times. Twelve of the last 14 dolphins tagged were also freeze branded (Figure 10; Evans et al., 1972). Taken together, our resighting results suggested that at least some dolphins resided in the area with a discernible home range boundary (Irvine & Wells, 1972). Our observations also provided the first documentation of sexually segregated social groupings and of subgroup cohesion.

Figure 9. The author (*left*) and dolphin collector Robert Corbin (*right*) hold a wild dolphin with a yellow button tag attached to the dorsal fin. The dolphin was subsequently released.

Figure 10. Holding the branding iron, the author inspects a recent freeze brand (#5) shortly before the dolphin was released.

Snakes

The dolphin–shark studies were completed. Given Simo's aversion to bull sharks, funding chances were nil for continued studies in the open ocean where bull sharks were prevalent. I needed to do something else.

Ignoring my history as a mediocre Sociology major and a poor test-taker in college, I thought that science must be in my future. I enrolled as an M.S. student in the Department of Zoology at the University of Florida (UF). Not having cracked a textbook in 6 years, coursework was a struggle. My years of solving research problems, however, helped research come more easily.

I studied the dive and breath-hold metabolism of the brown water snake (*Natrix taxispilota*). Snakes were perhaps a strange choice for me, being neither marine nor a mammal, but they were aquatic and they did dive and were available. These non-poisonous snakes, about 1 to 1.5 m in length, were known to bask in the lower branches of cypress trees extending over the water in a nearby lake. Capturing them required concentration and rapid hand-eye coordination. My wife, Barb, paddled our canoe slowly under a low-hanging cypress branch on which a snake was basking, and I, in the front of the canoe, grabbed the snake with two hands. A grab behind the head helped to avoid being bitten, and a grab near the tail usually prevented the snake's immediate defecation response from spewing feces everywhere as it thrashed.

Once caught, the snakes were housed in aquaria in the basement of Bartram Hall, although they sometimes escaped and were rumored to roam the halls late at night. I measured resting heart rate, diving bradycardia, and oxygen consumption during dives in a water-filled aquarium (Irvine & Prange, 1976). Results indicated that average heart rates were higher during forced dives compared to voluntary dives. Oxygen consumption was not significantly different during a voluntary dive or breath hold, but it was significantly higher during forced dives.

Manatees

In early spring of 1974, as I was finishing up my M.S. degree, I had a conversation with a friend, the late Howard "Duke" Campbell. Duke was a herpetologist, and he had trained with Ken Norris at UCLA before Ken switched from desert reptiles to marine mammals. We were having a social gathering at my house, and Duke started talking to me about manatees, a decidedly odd topic for a herpetologist. I remember sitting on my kitchen counter, sipping a beer with my back against the wall. He was about to start up the newest National Fish and Wildlife Laboratory (later renamed the Denver Wildlife Research Center; now the U.S. Geological Survey [USGS] Sirenia Project), a U.S. Fish and Wildlife Service (USFWS) initiative to study the endangered West Indian manatee (*Trichechus manatus*). Duke, knowing of my background with dolphins, was picking my brain about what skills would be needed to work with manatees, including how to investigate movements and distributions, and how to do hands-on work with them using nets for captures. We talked about people that I thought might be good for the job. And then he said, "What about you?"

I was stunned. I sat there, beer in hand, suddenly in the middle of a job interview. I was a dolphin guy studying water snakes, and I only vaguely knew what a manatee was. Having no certain career path on my near-horizon, however, this seemed like an interesting opportunity. In retrospect, this start was similar to how I became involved with dolphins—being ambushed by an opportunity to work on an animal about which I knew virtually nothing. Several months later, I accepted the first Wildlife Biologist position to study manatees.

As I was finishing up my M.S. degree and contemplating a career studying manatees, I was blindsided by another opportunity. While sitting in for my wife at the local art cooperative, John Twiss, Executive Director of the MMC, called me. He had tracked me down with difficulty, and he seemed a bit put out to finally find me in the middle of an art gallery. After a slightly awkward start, he told me that the MMC would look favorably on a short proposal to conduct a radio-tagging and behavioral observation study of bottlenose dolphins. The MMC was impressed with the work that Randy Wells and I had done in Sarasota (Irvine & Wells, 1972), and they wanted to see the work expanded. With that encouragement, I put together a three-page proposal. Having no experience writing a proposal, I asked Archie Carr, the distinguished turtle biologist residing down the hall from my UF office, if he would give me comments. He told me later that my proposal was so badly written that he called his old friend Bill Evans to see if I was "for real." Apparently, Evans told him I was, so Archie filled my three pages with red marks. Chastened, I cleaned up the proposal and submitted it, and it was accepted—one of the first contracts ever funded by the MMC.

So, there I am, in the summer of 1974, with two jobs: one working with manatees, a species that I knew little about, and one working with dolphins, a species that I did know something about, but mostly in captivity. I had no experience with radio tracking, or scientific field observations, or grant/personnel management, or budgeting. I realized I had to hire someone to work on the MMC contract, supervising them remotely, while helping to start the brand-new manatee program. I turned to Michael Scott and Randy Wells, splitting the meager grant salary.

The manatee lab was started under the direction of Clyde Jones, a small mammal, museum-centric biologist working out of the Smithsonian Institution in Washington, DC. He didn't like bureaucracies. They interfered with field work. Because of this, he shielded his field staff from the bureaucrats. Duke and I were soon joined by James "Buddy" Powell. Buddy was unique in that he actually knew something about manatees. He had been studying and swimming with manatees in Crystal River, Florida, since he was a kid; and when he was in high school, he volunteered to help Daniel Hartman on his Ph.D. dissertation (Hartman, 1979).

After reading all I could find in the scientific literature on manatees, I realized that I was not alone in my ignorance. For an animal that may be 3 to 4 m long and weigh 1,000 kg or more, they are surprisingly surreptitious and difficult to see. They often live in turbid water, they can stay submerged for at least 24 minutes (Reynolds, 1981), and when they do surface to breathe, little more than their nostrils may be visible (Figures 11 & 12). Much of what we did know came from a single Ph.D. dissertation by Daniel Hartman (1979), who studied manatees in Crystal River, the small, spring-fed river on the west coast of Florida where Buddy Powell swam with manatees. Taking advantage of the clear waters of Crystal River, Hartman made the first extensive behavioral observations of manatees; he documented summer distributions, and he identified natural and man-made warm-water refuges where manatees congregated during intense winter cold spells sweeping into Florida from the North.

We started with the most basic of questions: Where do they occur? How many are there? What are the threats to the population? To answer the first question, I sent out a thousand letters containing postage-paid postcards with survey questions about when and where manatees were sighted. They went to marinas, boat docks, yacht clubs, fishing supply stores, and even to restaurants on the water. The responses weren't overwhelming, but they confirmed reports of manatees being widely dispersed in the warm season as far as the Florida panhandle and into Georgia, and winter sightings were confined to the south. In saline environments, manatees showed little fear of humans or boats, and multiple reports described manatees drinking from freshwater hoses on docks and eating vegetation nearby. The survey was mainly successful at raising public awareness that manatees were closely cohabitating in Florida with its human population and that there was a federal agency interested in them.

Figure 11. A manatee (*Trichechus manatus*) respires while feeding on water hyacinths in 1975. The animal was difficult to locate to photograph, even from 2 m away. (Photo courtesy of USGS Sirenia Project)

Figure 12. A manatee surfaces to breath in open water, with little but the nostrils showing, making observations or data collection difficult. (Photo courtesy of USGS Sirenia Project)

To answer the second question on population size, we started flying aerial surveys in single-engine planes, first in small areas like Crystal River, and then expanding to statewide surveys in 1975. I organized simultaneous statewide aerial surveys during winter months. The logistics were daunting. We wanted to send up nine planes, with two observers in each, to cover the state shorelines and waterways. To do this, we had to recruit biologists from agencies across the state, along with Michael Scott, who transferred to the manatee program after the MMC contract was over.

Once organized, there was a short window to say "Go" for winter surveys because flights had to be timed immediately after passage of a cold front when manatees were most likely to be congregated in freshwater springs (Figure 13) or power plant effluents (Figure 14). Counting 50 or more scattered manatees from a plane circling at an altitude of 30 to 200 m was difficult because the animals were often clumped on the bottom (visible in clear water), with some surfacing to breathe or diving after a breath on each circle, and air turbulence exacerbated the problem. Counts at power plants were even more difficult: water visibility at some plants was less than 1 m, and we had to dodge the plant's tall smoke stack, being tossed about by the plant-generated turbulence. Surveying the narrow, twisting, turbid channels of the Everglades, the most natural warm-water refuge for the population, was its own kind of madness. A total of 738 manatees was reported in the winter surveys, undoubtedly an underestimate (Irvine & Campbell, 1978). The summer surveys counted 245 manatees, well dispersed and further north into the ranges reported by Moore (1951) and Hartman (1979).

Survey flights proved very productive, but I hated them. We flew frequently, on a weekly basis for some areas, and I would get at least "queasy" every time. Imagine flying at low altitude over a narrow Florida river, trying to count manatees, circling very tightly, airplane pitched on its side, catching an updraft when we crossed one riverbank, a downdraft when we circled back over the river, and then another updraft over the opposite bank. We would keep repeating this until sure of the count, and then move on to the next sighting for 3 to 4 hours. Michael Scott, who got queasy just walking up to a small plane, and I did eventually come to a workable solution. We cinched our seatbelts extra tight and flew with the passenger door removed (which was particularly invigorating during the winter surveys) while snacking on soda crackers and sucking on ice chunks. I still hated aerial surveys.

Figure 13. Manatees congregating near the main spring of Crystal River during a winter cold front; water temperatures remained at 20°C at the spring, which was well above ambient ocean temperatures. (Photo courtesy of USGS Sirenia Project)

Figure 14. Manatees congregating in the warm water from Florida Power and Light Co. Rivera Beach's power plant, one of the few power plant effluents with clear water (Photo courtesy of USGS Sirenia Project)

Answering the question about assessing population threats, particularly for an endangered species, was critical and multifaceted, but we started with a stranding program. We knew from scarring on manatees that they were frequently hit by power boats and that many were capable of surviving these boat strikes (Figure 15). In fact, seeing a manatee without obvious scarring was rare. We also knew from historical records that manatees were susceptible to cold snaps. Thus, to fully document the mortality, we tried to collect all the carcasses we could.

We started by building a stranding network. Daniel Odell, then at the University of Miami, agreed to cover the southern part of the state, while we took the northern and central areas. But we were in an office building without a vehicle, so we were not set up to handle mortality events. Michael Fedak, a temporary hire working for us while waiting for a university appointment in the United Kingdom, found us a beat-up 1940s-era Army-surplus pickup truck. Duke arranged with the Florida State Museum to store recovered carcasses in some woods outside of Gainesville, a veritable boneyard. Using contacts we established during our postcard survey campaign, we spread the word to marinas and the Florida Marine Patrol that we wanted to collect any dead manatees. Slowly at first, the calls came in. These were never fresh kills, so their badly bloated carcasses had a tendency to explode. Having no museum background or tools, and only an out-of-the-way woodland to conduct necropsies and store the decomposed carcasses, data collection was crude.

In 1977, a severe cold snap damaged a local power plant along the Indian River near Cape Canaveral, shutting down the warm-water discharge that the manatees depended upon to survive the winter. We were subsequently inundated with calls to retrieve dead manatees. The stranding runs to the Indian River were almost daily. In a single day, I loaded a total of five manatees into the pickup truck and a rented trailer. This experience convinced me that we needed a better method of transporting dead manatees. Possibly embarrassed by the appearance of our pickup truck, Clyde Jones conjured up a new vehicle. For my part, in my carport at home, I mounted a wooden platform and tie-down hooks to carry carcasses on a newly purchased boat trailer (Figure 16). Most importantly, Bob Bonde and Cathy Beck arrived from the Los Angeles County Natural History Museum and brought the lab's manatee collection and carcass recovery system up to museum standards.

To better understand changes in manatee movements and distribution, effective marking and tracking techniques were a major necessity. Moore (1956) and Hartman (1979) used scars to identify individuals, as have others subsequently, but these marks can only be seen reliably from close range in clear waters. Marine mammal tagging was in its early stages in those days (Evans et al., 1972). Freeze brands used on dolphins had potential (Evans et al., 1972; Irvine & Wells, 1972), but unless they were very large, they were difficult to see from a distance. Sonic transmitters worked in freshwater and marine environments but had limited range. Radio tags transmitted through fresh water; however, in a marine environment, the signal was attenuated until the device's antenna broke the surface.

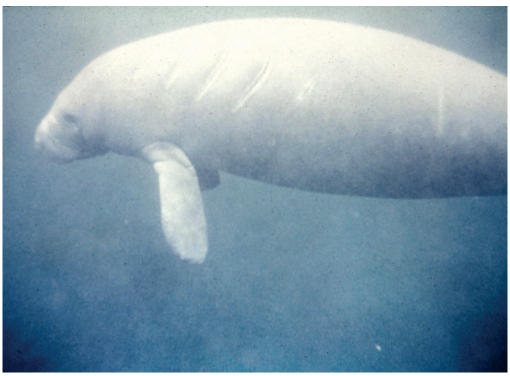

Figure 15. Deep healed scars, inflicted by a boat propeller, are visible on the side of a manatee in 1976. With the advent of a resighting program, this animal was identified by the scars on 77 occasions from 1982 to 2018. (Photo and data courtesy of USGS Sirenia Project)

Figure 16. Carcass-transport trailer with newly retrieved manatee. The bloated body condition was not unusual. (Photo courtesy of USGS Sirenia Project)

Attaching a tag to a manatee was a challenge because only the nostrils or head may reach the surface (Figures 11 & 12), and there are no obvious appendages for attachment of a tag such as a dorsal fin in most dolphins. So, over the next several years, in concert with other research activities, we developed and field-tested various tags and tagging techniques on captive and wild manatees (Irvine & Scott, 1984). Twelve manatees were captured in a dredged inlet at the north end of the Banana River at the Kennedy Space Center, and they were either immediately tagged and released or trucked to Marineland of Florida in St. Augustine for metabolic tests and tag testing before being released at their capture site.

Manatees captured and released, and those at Marineland, also provided new clinical data in cooperation with colleagues from the UF School of Veterinary Medicine (Irvine et al., 1980) and Department of Dairy Science (Bachman & Irvine, 1979). We made discoveries in methodology—quickly learning, for example, that it was extremely difficult to intubate an adult manatee for stomach contents analysis or to insert a thermal probe because even when restrained, the animals thrashed violently, and they were too large to adequately restrain without compromising their respirations. The solution, discovered by Dr. Paul Cardeilhac, DVM, was to pass the tube through the nasal passage, which the manatees accepted with surprising calmness. Urine collection from animals was difficult because they urinated at will but strongly resisted catheterization attempts. The solution, suggested by Michael Scott, was when the tank was drained and the manatee was resting on the bottom, to roll the animal's urogenital area onto a frisbee. When the animal urinated, a small tube drained the contents from the frisbee into collection tubes (Irvine et al., 1980).

We tested 20-cm freeze brands, which were very large versions of the type used on dolphins (Figure 17). Spaghetti tags had been shown to be effective on dolphins (Evans et al., 1972), but we were not optimistic because the dart of the tag was difficult to insert into the tough manatee hide. With a small sonic tag attached to a spaghetti tag, manatees were tracked in freshwater and marine environments for up to 24 hours, but the range was 25

Figure 17. The author examines a 20-cm freeze brand on manatee BR-10 at Marineland of Florida. The missing part of the tail fluke was apparently caused by a boat strike prior to its capture. (Photo courtesy of USGS Sirenia Project)

to 400 m, depending on local conditions. We also experimented with using sutures to attach a radio transmitter behind the skull of two manatees in captivity. The thought was that, with that placement, the radio antenna would reach the surface to transmit when the manatee took a breath. To test differences of the time the antenna was on the surface, "BR-10" (the identification code for the first tagged dolphin) had a flexible upright antenna, and "BR-12" had an antenna attached to a float 30 cm behind the radio. When the manatees were released, signals from the floating antenna design ceased after 19 days, while transmissions were received from BR-10 for 28 days after release. In fact, I called Michael Scott one evening at his motel in Merritt Island, Florida, and during the call, he was recording respiration intervals when BR-10 surfaced in the nearby Indian River. Radio signals soon ceased, however, and a week later the animal was spotted without the transmitter. BR-10 was sighted, presumably by his freeze brand, a total of 38 times in the next 18 years, ranging from Cape Canaveral to Ft. Pierce, Florida, about 240 km to the south.

Taken together, the tag-testing results were disappointing but not surprising. We did not find a method to track manatee movements over time. Ancillary testing with our captive manatees, however, demonstrated a potential solution. By cooperative agreement with the University of Minnesota, two manatees were fitted with straps around the peduncles that were worn without harm to the animals for 7 weeks just prior to their release. Peduncle straps were later fitted with radio transmitters, which could broadcast in fresh water, as part of John Bengtson's (1981) study of manatee movements in the St. John's River, Florida. Later, a floating radio transmitter assembly, which allowed the antenna to get to the surface, was developed by Galen Rathbun and colleagues (1987), thus allowing researchers to study manatee movements in saline environments, to be followed by use of satellites to track manatee movements (Mate et al., 1986). These breakthroughs have finally led to needed insights into seasonal distributions and the behavioral ecology of manatees (Rathbun et al., 1990; Reid et al., 1991, 1995; O'Shea et al., 1995).

Manatee distributions shrank during colder months and expanded during warmer months. The assumption was that a low metabolic rate and poor insulation made it hard for manatees to maintain their body temperature in cold water (Hartman, 1979). Having measured oxygen consumption in water snakes, I thought I could scale up the setup to measure manatee metabolism

(Irvine, 1983). Three of the manatees captured in 1976 and 1977 at the Kennedy Space Center were tested at Marineland of Florida in warmer and colder months. A small tank off the main holding tank was used to isolate individual manatees. It was sealed for oxygen measurement, and manatee body temperature was simultaneously measured with an ingested thermal transmitter. For cold water testing, water temperature in the tank was reduced with crushed ice. The results confirmed that manatees have exceptionally low metabolic rates, which were 17 to 22% of predicted rates based on body weight calculations. Thus, lower water temperatures become metabolically expensive for manatees. Manatees that usually spend 6 to 8 hours/day feeding (Hartman, 1979) would need additional time feeding to meet the metabolic demands of colder temperatures. Cold effects are likely compounded by consumption of food and ingestion of water into the gut at ambient water temperatures. Manatee cold tolerance is unknown, but historical winter range limits approximately correspond with the minimum 20ºC isotherm where cold-related die-offs have occurred during periods of severely cold weather in Florida (e.g., 0ºC air temperature in southern Florida).

Back to Dolphins

The manatee-related activities described above took place from 1974 to 1978. From 1974 to 1976, as also described above, I took on the MMC contract to study dolphins. Previously, Randy Wells and I had reported tantalizing hints about the possible social structure and movements of bottlenose dolphins—that tagging data were collected opportunistically because the dolphin collector declined to capture groups without "clean" dolphins for him to sell (Irvine & Wells, 1972). The MMC contract allowed us to catch as many dolphins as we wanted, to radio tag up to ten of them, and to conduct regular boat surveys to identify the movements of tagged animals. The total award was $22,969 for Year 1, with $30,700 funding subsequently for Year 2. It was a bit crazy for me to take it on while working full time on manatees, but it was too good of an opportunity to pass up, and I didn't know any better.

I quickly realized that I needed infrastructure in the form of institutional support, and somebody to help, and a boat, and a dolphin capture net, and a place to do the study, and most of all, a plan. My status at the University of Florida, which sponsored the MMC contract, was somewhere between unclear and awkward. I was an about-to-be former M.S. grad student and soon-to-be federal biologist working on manatees across town, but I had a substantial federal contract to UF. The smartest thing I did was plead to the tender mercies of Donna Gillis, the Zoology Department secretary. She liked me a little, and she liked dolphins a lot. I even promised her a boat ride to look at dolphins if she'd take me under her wing. And to my everlasting gratitude, she agreed. She coached and cajoled and covered for us as we did our thing for the next 2 years.

Having no work experience except as a dolphin trainer, I thought it'd be good to get some inkling of electronics, which might help me understand the radio-tagging technology I had proposed to embrace. Hence, I took a class in Electrical Engineering 101 (i.e., for dummies). How fortuitous. For in that class I met Michael Scott. We first bonded as both being from southern California and playing volleyball, but Michael also was a grad student for Dave and Melba Caldwell at Marineland of Florida, studying bottlenose dolphin signature whistles. Even so, he was intrigued by the idea of radio tracking bottlenose dolphins for my MMC contract.

Michael seemed easy to work with and was comfortable with electronics, which I was not. He was eager to get out of the lab to get involved in one of the first field studies on dolphins. My challenge, however, was that the Caldwells had always been very nice to me, had willingly offered advice, reviewing manuscripts with kind comments, and they published our paper suggesting year-round dolphin residency (Irvine & Wells, 1972) in their journal *Cetology*. They, along with Bill Evans, were also listed in the MMC contract as consultants, which added to my credibility to get the contract. And now I was going to steal Michael, their Ph.D. student, away from them? They would never forgive me. I felt badly about luring Michael away, but I was desperate. And I was right. Michael was a perfect fit for the job, and the Caldwells never forgave me.

Also, we needed a boat and a dolphin capture net. Randy's dad, Jack Wells, had a contact at a local boat building factory, and we were able to purchase, at cost, an 8-m inboard-outboard boat with a small cabin. Somehow, I also found a used 3-m observation tower for the boat and a bay-front restaurant willing to allow us to dock the boat for free. Finding a robust net, about 450 m long and 3 m deep, to capture dolphins seemed impossibly expensive at first. Then I heard about a commercial dolphin collector who needed cash quickly to cover legal expenses incurred by dope smuggling charges. He readily agreed to sell me his 457-m dolphin capture net. With that, we had the essential equipment to start the project.

A plan gradually formed during the weeks needed to seduce Michael to work on the MMC contract. Meanwhile, equipment purchase orders traversed the UF bureaucracy. The contract called for me to do the research based out of St. Augustine, Florida, where the Caldwells would advise. Having burned my bridges with the Caldwells, the project was switched to Sarasota, Florida, where dolphins we tagged in 1970-1971 were likely to still be present. My plan was that Michael would live in Sarasota, track radio-tagged dolphins, and conduct regular dolphin observational surveys in our new boat. I would commute from Gainesville for dolphin tagging, and Randy, now a senior at the University of South Florida in Tampa, would analyze some of the data collected for a Master's thesis through UF and spend as much time in Sarasota working with Michael as he could.

A potentially awkward situation between federal agencies was averted, seemingly with a casual wink and a nod. The USFWS (Department of Interior) was tasked with the recovery of the manatee as mandated by the Endangered Species Act. Dolphins were the domain of the National Marine Fisheries Service (NMFS; Department of Commerce) and were protected under the 1972 Marine Mammal Protection Act. Both USFWS and NMFS guarded their turf and their budgets, sometimes like territorial males during rutting season. The MMC belonged to neither agency, and it provided the contract, but implementation depended on good will that would allow me, a USFWS employee, to work on dolphins. Happily, Clyde Jones and Duke Campbell worked with the USFWS and NMFS to bless the MMC contract and my time working on it.

The next daunting task was to teach Michael to drive a boat. If you've tried to learn to do that as an adult, you know that driving roughly straight ahead is pretty simple. Learning to dock a boat, however, which is crucial, can trash a person's preconceived notions about hand-eye coordination, sense of timing, and depth perception. The boat driver needs to approach slowly, then put the engine in reverse to slow progress while turning the steering wheel in the opposite intuitive direction so the reverse propulsion brings the stern sideways to gently rest against the dock. Once touching, or almost, you or a passenger can quickly jump onto the dock to tie off at least one line from the boat before it drifts away from the dock. As soon as our boat was launched, I made the 4-hour drive down to Sarasota to teach Michael to drive it. We were in a small bay, the wind was light, and few other boats were around. I threw two empty gallon jugs, each anchored to a brick by light line, into the water near each other. I demonstrated to Michael how to park the boat next to the floats as if they were a dock. Then, thinking about my 4-hour drive home, I went below and took a nap. Michael worked at parking the boat for some time, even sinking the floats at one point, but he generally got the hang of it. I showed him a chart with our current position and that of the tie-up at the boat's restaurant dock, and I sent him off to find his way there in the boat while I drove home. In hindsight, it was a damn-fool thing for me to do. Sending this novice boat driver who knew nothing about handling wakes from passing boats and navigating by chart was nuts. Also, I had forgotten that the restaurant mooring was subject to strong tidal flows and swirling winds. Plus, it had large pilings which complicated docking and tying off a smaller boat. I subsequently heard stories about Michael's travails trying to dock our boat there. His go-to move when things were dicey: "Hit the dock with the pointy end of the boat until it sticks." Then it was up to him, one of his crew, if any, or occasionally even the restaurant owner, to tie the boat to something solid as a prelude to a proper mooring. With only tongue-in-cheek complaints later, he learned by trial and error and soon became a seasoned boat handler. And a story teller.

Sarasota Bay and the waters north to the southern edge of Tampa Bay are protected by a chain of barrier islands, broken by occasional passes to the Gulf of Mexico (Figure 18). The Intracoastal Waterway is a dredged channel extending through Sarasota north into Tampa Bay. In our previous tagging work in the area, dolphins proceeded to the southern edge, but not into Tampa Bay, suggesting this was the northern limit of their home range (Irvine & Wells, 1972). These "urban" dolphins frequently pass close by pleasure boaters and commercial fishermen. Consequently, dolphins may be observed from close range in a slow-moving boat without creating a disturbance. Except in open water areas, wind is often not a factor, and dolphin-watching is not difficult.

In January 1975, we were ready for our first attempt to radio tag a dolphin. We had borrowed a radio tag and radio-signal direction finder array from Bill Evans. A 251-cm male dolphin, designated "RT-1," was fitted with a radio tag bolted through the dorsal fin (Figure 19), which was designed to fall off after the radio tag battery failed. The radio tag had a stiff wound-spring antenna to keep it vertical, increasing chances that the radio signals would be received each time the dolphin surfaced. The dolphin was captured, tagged, and released without a hitch. About 2 hours after release, however, radio signals ceased and were not re-acquired. We were crushed. The dolphin was subsequently seen over the next several years without the tag.

In April 1975, our next radio-tagging attempt on RT-2, a 210-cm male, went much more as we had hoped. The dolphin, nicknamed "Sparks," was interesting because it had survived an apparent shark bite, resulting in the amputation of almost

Figure 18. The Sarasota dolphin study area for the MMC contract in 1975-1976

half of one blade of his tail fluke. Michael, Randy, and I tracked him for 24 hours after release. Much of the first night was spent anchored, receiving signals at the mouth of Palma Sola Bay (Figure 18). As the sun rose in the morning, with Michael dutifully recording surface-intervals, I remember that we were feeling confident that the idea of studying wild dolphins actually would work. We now had the technology to follow radio-tagged dolphins, and we knew from experience that we would see recognizable dolphins during boat surveys. This may have been when the phrase "natural laboratory" for dolphin research was first coined for the Sarasota Bay area. In any case, we speculated about the veritable treasure of previously unavailable data that might be collected from identifiable wild dolphins. Our contract called for collection of data on length and sex from all dolphins we captured, but what if somebody could get body weight and blood, study acoustics, and do boat surveys over time? "Nah," I said, "It'll never happen because nobody gets paid to do dolphin field work." Randy didn't believe me. And he was really stubborn.

Over the next 15 months, we returned eight more times for dolphin capture, tagging, and release. When I set a capture date, different gears were set in motion. I had to arrange with the UF to get $200 to pay in cash to a soon-to-be identified dolphin collector who Michael was to find by capture-day. Even with the promise of a signed receipt, the UF bureaucracy was extremely uncomfortable writing me a check that I would cash to pay an unnamed individual. I had arguments every time, and it was always with somebody new because I was referred elsewhere by the uncomfortable person who did it before. I even pretended to threaten a lawsuit against UF a couple of times for impeding a federal contract. Meanwhile, I tried to recruit volunteers to go with me for 2 days to capture dolphins. Sometimes I even trolled the bars. My ideal volunteer was big—a wrestler or rugby player who could swim. I also arranged to borrow the USFWS Boston Whaler from the manatee project, a truck to tow it, and all three of the USFWS hand-held radios.

Michael meanwhile was rounding up any volunteers he could find, usually the small female New College undergrads who were involved in the survey and tracking (Scott, 2018). He had to create a saddle out of fiberglass and foam to attach the radio to the dolphin. He made peanut butter and jelly sandwiches and provided doughnuts for the crew. And most importantly, he had to schedule a fisherman who had a fast boat that could carry our net and would do the 2-day job for a total of $200. In cash. I somehow found the first fisherman–dolphin collector, but he disappeared after a drug deal gone bad. Michael found the next one, a tall mullet fisherman named "Snake." The worst thing I did to Michael during this time was to set a capture date with only a day-and-a-half notice because of a winter weather window. Michael, who doesn't drink and was shy by nature, had to troll the local bars that night asking for "Snake," and then build the new dolphin saddle and arrange the local logistics the next day.

Dolphin captures usually were 2-day affairs. The night before Day 1, I descended on the home of Randy's parents in Sarasota with my latest crew of volunteers from Gainseville. We were always welcomed, and sleeping bags were thrown everywhere, sometimes filling the living room. We were off before dawn the next morning to meet up with the capture boat, which had by that time loaded the capture net from its home in the shed behind Fran and Jack's house. We returned that night dog tired, slept on the floor again, and we left early the next morning. At the end of the 2nd day, the fisherman was paid, the Gainesville crew made the 4-hour drive home, and any remaining troops disbanded. Michael was left with extra PB&Js, miscellaneous debris, and data to be put in order.

Figure 19. Michael Scott hovers behind a radio tag attached to a fiberglass saddle bolted through the dorsal fin of RT-1. The spring antenna design maximized chances it would reach the surface to transmit each time the dolphin took a breath. The antenna was moved aft and made more flexible on subsequent radio iterations.

Dolphin Captures

Our fishermen used their own mullet-fishing boats—fast, shallow-draft boats with the engine sitting in a well about 2 m aft of the bow; this allowed the 457-m long net to be set over the stern. The net was 3 m deep with floats on top and small weights to make the bottom sink quickly. A group of dolphins approached in shallow water will often swim away together rapidly. Moving faster than the dolphins and trying to stay on a parallel course, the net boat starts the set by flinging one end of the net off the stern, which drags more off when it hits the water. The net boat must then cut in front of the fast-swimming dolphins while still laying net, and then turn back to the starting point, closing the circle before the dolphins reverse and escape the way they came. If the water is less than 3 m deep, the net usually hits the bottom before the dolphins can escape under it. Meanwhile, depending on where boats were positioned when the set started, the USFWS Boston Whaler was either following the net boat around the circle or going the opposite direction hoping to create noise and a bubble screen to discourage the dolphins from reversing their course and escaping. In about 12 seconds, the dolphins were encircled. Or not.

The net diameter could be as much as 145 m, a large area to patrol for dolphins that hit the net and entangle. Optimally, the dolphins remain near the middle of the enclosed area. Suboptimally, and only occasionally, one or more dolphins will immediately try to break out of the net enclosure by ramming the net, which usually causes entanglement in the net. A wild dolphin tangled in the net needs rapid human assistance in the water to prevent it from drowning. That becomes the first priority. The survey boat, with the smallest team of crew members, was soon towed to near the net to avoid the chance that the dolphins might associate the boat's engine with captures and avoid it later.

Eventually, the humans needed to get hands on the dolphins, some of which were up to 2.5 m long and weighed 200 kg or more. Usually the net was pinched multiple times to decrease the enclosed area and separate dolphins so they can be handled individually. We soon learned that recaptured dolphins tended to become passive, often allowing themselves to be grabbed by only one of us, virtually without resistance. With only a small team of humans, one or more passive dolphins made it much easier to focus on first-timers that required the most person-power while they were measured, tagged, and released.

Compared to the old days, Randy and I felt rich with resources. In 1970-1971, we sometimes were the only crew on the only boat. In retrospect, no way should I have allowed a teenager to be involved in what was occasionally dangerous work trying to subdue a struggling dolphin in the net. For the MMC contract, we not only could set on any dolphins the collector thought he could catch in shallow water, but we had three boats and as many as 12 volunteers to help move nets and hold dolphins. The walkie-talkies were a big bonus, but the batteries wore out by about 1500 h every day, which usually made coordination of boat movements difficult after that. We accomplished a lot, and Randy, Michael, and I grew a friendship that is still solid today (Figure 20).

At times, the entire operation had a by-the-seat-of-the-pants feel, probably because we often had to make it up as we went along. There were no standards. Between our capture-visits, Michael tracked dolphins with functional radio tags, and he invented replicable boat survey routes to identify tagged dolphins from the *Black Cloud*, so named because of repeated mechanical difficulties. Data sheets were altered multiple times to facilitate data compilation and to include variables besides dolphin identity. Just accurately plotting a sighting location was difficult—no GPS back then. And I remember long discussions to settle on a definition of what constituted a dolphin group (e.g., proximity [defined as . . .] and activity [defined as . . .]). We worked hard to refine our techniques that would become the foundation for future years.

Over the course of the study, we put a total of 90 tags on 47 dolphins, which were sighted a total of 910 times (Irvine et al., 1982). Starting with "RT-3," the next eight radio tags were redesigned, and saddles were constructed out of fiberglass by Michael from a plaster model of a dorsal fin. By today's standards, the radio tags were clunky, but they provided movement data for up to 22 days, all within the study area. We also tested roto tags, spaghetti tags, and freeze brands (Figure 21), one of which could be read 4 years and 9 months after it had been applied in 1971. Tags attached to the dorsal fin were not to be recommended, being vulnerable to breakage, marine fouling, or attachment-bolt migration, any of which might harm the dorsal fin. Twelve dolphins had fins with natural marks or disfigurements that made them recognizable, and the marks on one dolphin were documented over a 10-year period (Wells et al., 1981).

At the time of this writing, the study of the Sarasota dolphin population is in its 50th year: 1970 to 2020. Our start in 1970-1971 provided an inkling, and results from the MMC contract confirmed and expanded on those findings (Irvine et al., 1981). Because of our boat surveys, we were able to define a resident dolphin population with a determinable northern home range boundary at the southern edge of Tampa Bay (Figure 22). One of the first descriptions of wild bottlenose dolphin social structure was provided by Randy in his 1978 Master's thesis.

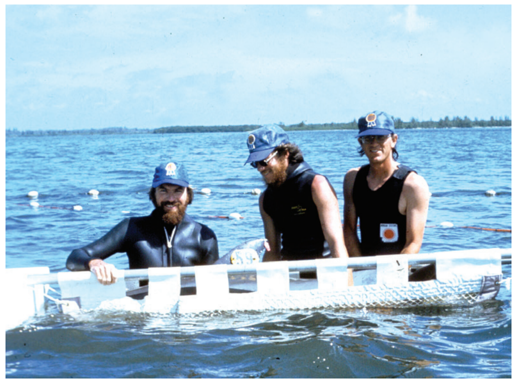

Figure 20. From left, Blair Irvine, Randy Wells, and Michael Scott in 1975 with a newly captured dolphin sporting a #59 yellow visual tag and an orange roto tag near the dorsal fin tip. The dolphin was released soon after this photo was taken.

Figure 21. Dolphins with different tag modalities. The orange fiberglass saddle with a radio tag in the foreground has a transmitter with rear antenna on the near side, with a connection to a battery pack on the far side of the fin. The dolphin at left has a rectangular visual tag and a smaller yellow cattle ear (roto) tag on the trailing edge of the fin. Note the freeze-brand numerals on the bodies of the two nearest dolphins. The 3rd animal from the bottom has two roto tags on the dorsal fin.

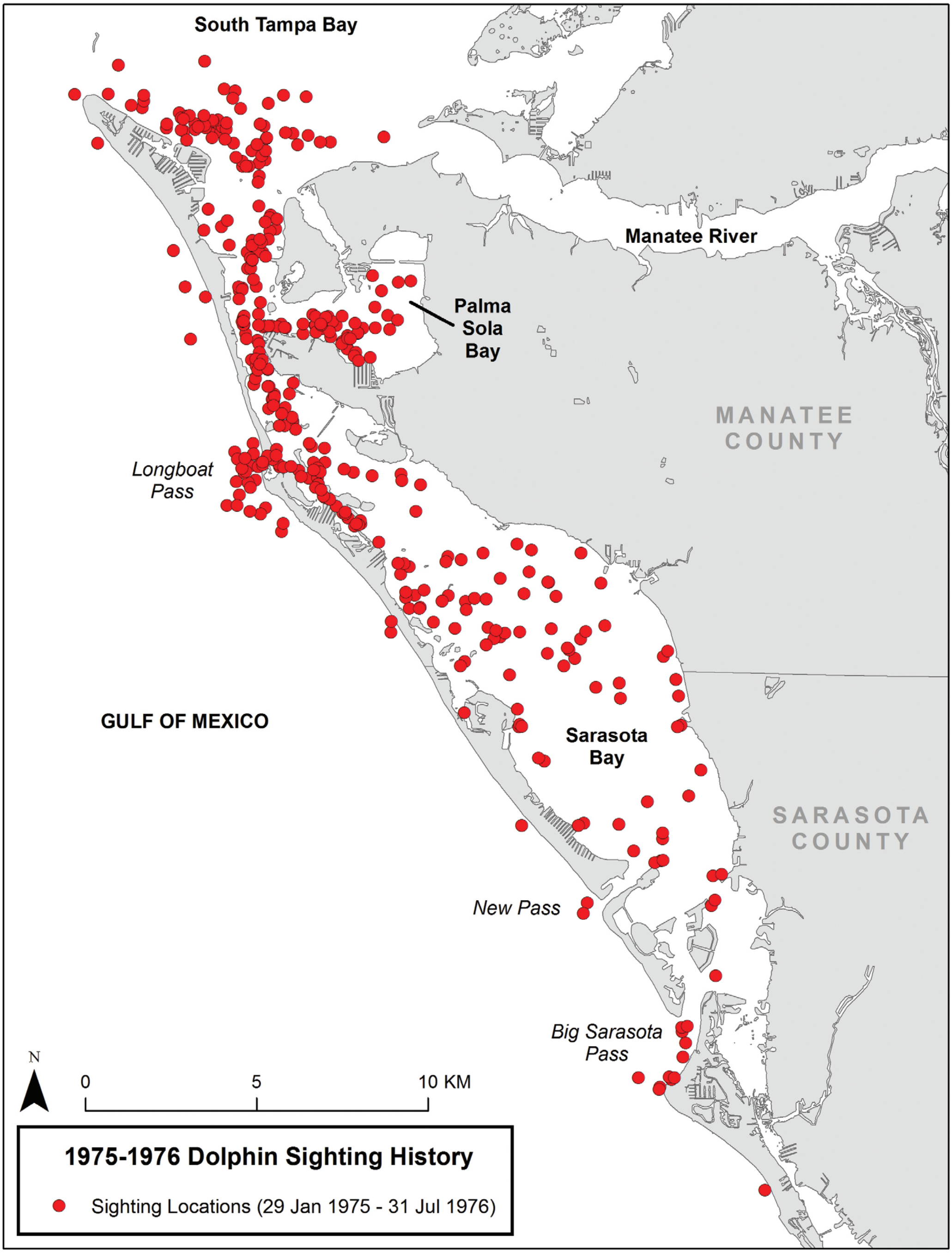

Figure 22. Sightings of identifiable dolphins during 1975-1976

In July 1976, the MMC contract funding ended, and I resumed working full time on manatees. Michael came to work half-time, often working full-time, with USFWS on manatees, helping out with captures, tagging, aerial surveys, and carcass recovery, while Randy finished his Master's degree (Wells et al., 1980). And we all went back to Sarasota occasionally, borrowing the boat from Randy's parents to look for recognizable dolphins. Randy did a Ph.D. under Ken Norris using Sarasota dolphins as part of his dissertation. In 1989, he took a position as a Conservation Biologist with the Chicago Zoological Society (CZS), studying dolphins in Sarasota. In doing so, he proved me wrong. It was indeed possible to get a job studying wild dolphins. As for Michael, in 1979, he signed on to become embroiled in the tuna–dolphin issues in the Eastern Tropical Pacific for the Inter-American Tropical Tuna Commission.

In the late 1970s, I began to realize that marine mammalogy was not a good fit for me and the family life I desired, but it took several years to figure out what was next. I left the USFWS in 1980 for a Master's degree in Exercise Physiology (Irvine et al., 1985), and an eventual Ph.D. from the University of Oregon in Eugene, where my family settled for good. While I never lost my interest in marine mammals, I never regretted changing careers. I ended up well satisfied with a people-focused career developing behavioral interventions with National Institutes of Health grants on topics including parenting (Irvine et al., 1999, 2014), older adult exercise (Irvine et al., 2013), and employee back pain (Irvine et al., 2015). The most rewarding of these projects was a body of work related to training family and professional caregivers of persons with dementia, culminating in a randomized study demonstrating that professional staff communication training can reduce resident aggression (Irvine et al., 2012). Meanwhile, I never quite left marine mammalogy. I've had the pleasure of staying involved with Randy, Michael, and the Sarasota Dolphin Research Program, which has grown beyond our wildest imaginations. In 1982, we formed a nonprofit, now called the Dolphin Biology Research Institute, to support our research efforts in Sarasota. In 1984, Randy initiated periodic dolphin capture–release projects, first to obtain life history information, and subsequently incorporating health assessments. For 30-plus years, Michael and I came down to lead volunteers in the nets. We have recently handed off those chores to the next generation. (And speaking of the next generation, those readers who are trying to find their way in marine mammalogy might be interested in my "Advice to Students" interview response. This video clip is available on the *Aquatic Mammals*' "Supplemental Material" webpage: https://www.aquaticmammalsjournal.org/index.php?option=com_content&view=article&id=10&Itemid=147.)

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