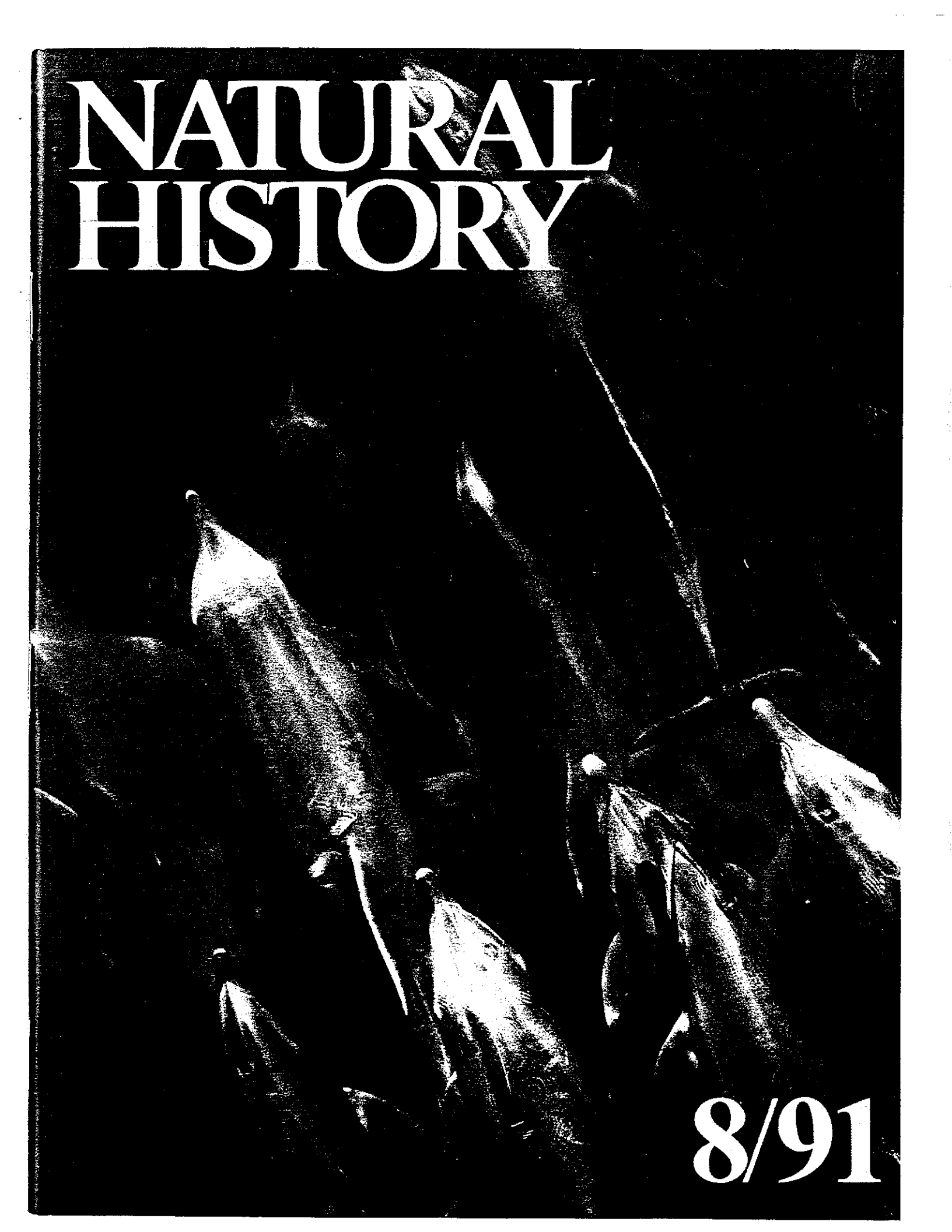


NATURAL HISTORY



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IF YOU NEED ME, WHISTLE

by Peter Tyack

As far as we know, humans and marine mammals are the only mammals that modify what they say in response to what they hear. The vocal repertoire of most mammals is essentially inherited, and learning plays little, if any, part in the sounds they produce—hybrid monkeys make hybrid calls and even deaf kittens make normal meows. Dolphins, in contrast, as biologists and dolphin fans have long known, readily learn to imitate sounds in captivity. Much remains unknown, however, about the role of learning in the development of the whistles that wild dolphins use to communicate with one another.

From captive animals, researchers discovered decades ago that a dolphin can whistle on the day it is born. These early whistles are quavery and variable. Before it is a year old, however, each dolphin develops its own distinctive "signature" whistle, as recognizable as a leitmotif in a Wagnerian opera or the tunes Prokofiev used to represent the various animals in *Peter and the Wolf*. Dolphin whistles rise and fall in frequency like a tune, but they last only a second or so, and the frequencies are more than ten times higher than a dial tone. Humans must slow down recordings of dolphin whistles to hear them well.

Studying whistle development in the wild has proved challenging, for dolphins can whistle underwater without exhaling bubbles. This trick comes in handy for them (allowing them to recycle air between breaths) but frustrates researchers trying to tell who's whistling. Eight years ago, I took up the challenge, hooking up with Randall Wells's ongoing wild dolphin study near

Sarasota, Florida. Wells's project provides a natural laboratory in which to study the vocalizations of wild dolphins. In the coastal waters off Sarasota, the animals' home ranges are small; researchers can set out each day to look for particular animals and be reasonably sure of finding them. Still, determining which is the whistling dolphin in a free-swimming group is seldom possible, so we temporarily restrain the animals in a net corral, attach underwater microphones, or hydrophones, to their heads with suction cups, and record them.

Over the years, our recordings have confirmed that, like their captive cousins, wild dolphins develop signature whistles, and that the signatures stay the same for more than a decade. Graduate student Laela Sayigh has concentrated on whistle exchanges between dolphin mothers and their young calves. When we corral a group with a mother-calf pair, we keep them together, holding one of the pair in shallow water while the other is measured in a rubber raft. Mothers and their calves usually start exchanging whistles as soon as they are out of each other's sight.

We have analyzed whistles from nearly forty mother-calf pairs. When Sayigh compared whistles of male and female calves, she discovered that males shape their whistles to become like those of their mother; females modify theirs to become distinct from hers. These gender differences may reflect differences in the lives male and female calves will lead. For most of their lives, females associate primarily with members of their own matrilineal group. If several females within a group had similar

whistles, a young calf might have trouble maintaining contact with its mother. Males, in contrast, eventually leave their natal group, so there may be little advantage in developing whistles different from a mother's; they may even benefit from sounding like her. Recognition of mother-son relationships could limit inbreeding. Also, adult males form coalitions that compete with other males for access to females; having similar whistles could help brothers recognize one another during interactions within and between coalitions.

The duration and loudness of signature whistles may vary when a dolphin is alarmed, but the whistles still retain their individual distinctiveness. Dolphins usually produce their own signature whistles, but they occasionally make different whistles. Some of these appear to be one-shot bursts of sound, but others are precise imitations of the signature whistles of companions. These imitation whistles appear to be for the purpose of calling one another "by name." One whistle exchange we recorded in 1984 illustrates how this works. After encircling six dolphins in the net corral, we put one, a thirty-four-year-old female we call Nicklo, in the raft. She whistled constantly, once every three seconds or so, during her hour there. Halfway through this hour, Nicklo started to imitate the signature whistle of another female in the corral, Granny, who was forty years old at the time. Nicklo continued to intersperse her own signature whistle with imitations of Granny's until she was released. Nicklo's own 3½-year-old calf was also in the corral, but Nicklo only "called" Granny, perhaps because as the

and associated organisms form the nutritional base for the food web supporting the fish, many of which grow up to become food for the dolphins.

Mothers and calves spend, on average, nearly five and a half years together (although we have known the period of close association to last as long as eleven years). The two swim together continually until just before the birth of the next calf. During this time, the calf reaches more than 85 percent of its adult body length and about 55 to 70 percent of its adult weight.

Most calves are raised within bands of mothers accompanied by their youngest calves. Mothers in a given band share the same range within the nursery areas de-

scribed above. Our field observations, and genetic tests by Debbie Duffield at Portland State University, indicated that a given band may be composed of several maternal lines that have associated closely for several generations.

During the course of a day, however, we rarely find all the members of a given band together. Typically, they break up into smaller schools of two to five pairs each; throughout the day, different schools from the same band may meet up and spend time together. For example, when we first saw the female A-4 with her new infant last fall, they were in a seagrass meadow with six other members of the Palma Sola Band. Their associates in-

cluded Granny and her newborn, along with A-3 and her yearling daughter and B-4 with her daughter. Twenty minutes later this group was joined by three other Palma Sola Band members, including Ms. October, with her yearling daughter, and Merrily, Granny's five-year-old daughter. The two schools merged and swam slowly to the south over the shallows. If we had followed them long enough, we would probably have seen them split up again into different, smaller groups or merge with yet other members of the band.

Within bands, swimming partners appear to be determined by reproductive state. Mothers with calves of similar age tend to swim together, as in the case of A-4

oldest in the group, Granny was the dolphin most likely to have had experience with this frightening situation and therefore the one most likely to be able to help or reassure Nicklo. As soon as Nicklo started imitating her, Granny responded by synchronizing her own whistle with Nicklo's imitation of it. No other dolphin responded at any time, not even Nicklo's calf.

On land as in the sea, mammals are capable of recognizing one another, and very often the recognition is based, at least in part, on voice. Slight variations in the vocal tracts of terrestrial animals lead to predictable differences in the voices of individuals. When friends call me on the telephone, I do not need to wait for them to identify themselves; as soon as they say hello, I know who it is.

In water, however, and especially for diving animals, these involuntary characteristics of voice are not as reliable. Vocal tracts are gas-filled cavities, and as an animal dives, these gases halve in volume for every doubling of pressure. Since some parts of the vocal tract are more elastic than others, changes in volume will lead to changes in shape that, in turn, may alter the sound. If dolphins and other diving animals do indeed rely upon individually distinctive calls, and use their vocal tracts to produce them, then they may need to create the calls by learning to modify acoustic features under voluntary control, such as the frequency modulation of whistles.

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and Granny. Seasonal reproduction results in the production of age cohorts, that is, individuals of the same age that grow up together. Calves of a given cohort begin to develop social relationships with one another from the day they are born. We commonly find two or more young of the year frolicking within a "playpen" formed by their mothers five to ten yards away.

Safety is most likely a prime advantage of growing up in a school of mothers and young. Danger, in the form of several species of large, predatory sharks, lurks in the deeper waters of the dolphins' home range. Mothers and young pass through these deeper waters while traveling from one nursery area to another. Dolphins

probably do not form a significant portion of the diet of any of the local sharks; nevertheless, more than 22 percent of the dolphins we have handled (other than dependent calves) had shark-bite scars. Tiger, bull, and dusky sharks may be responsible for most of the attacks.

We have seen only two young calves with shark-bite wounds. Possibly, shark attacks simply result in a quick death and disappearance of the calf. Perhaps, however, group living is effective protection. The calf Hannah lost to sharks, for example, never had the benefit of group living, for Hannah does not belong to a band and seldom swims with other dolphins. Ken Norris and Tom Dohl, of the University of California, Santa Cruz, have suggested that by pooling their senses, schooling dolphins (or fish, for that matter) can enhance their awareness of their environment, including predators. With dolphins, this means not only more eyes (in clear water) and more ears but also more echolocating clicks going out in many more directions than a single animal could keep track of.

During a birth at Chicago's Brookfield Zoo, a fluke appears first. The calf took two hours to emerge and then swam unaided to the surface for a breath.

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Group living is also an excellent way for a young dolphin to learn about the intricacies of life within its community. And there is much to learn: how far its home range extends, how to find and capture prey, how to identify and respond to potential predators, how to recognize other dolphins, and who fits where in the dolphin social hierarchy.

One anecdote suggests that dolphins may learn at least part of their forty-eight-square-mile home range within the first year of life. Merrily, a nine-month-old female, became entangled in a fishing net near the northern edge of the Sarasota community's home range. By the time she was freed from the net fifteen minutes later, her mother, Granny, had left. Several hours later, Merrily was seen alone in a bay four miles to the south, in the center of her mother's core area. By the next day, she had returned to Granny's side. Given the number of directions Merrily could have traveled in, knowledge, not mere chance, must have been her guide.

In captivity, bottlenose dolphins have shown themselves to be capable of learn-

ing to recognize individuals of their own and other species. In the murky waters inhabited by many wild bottlenose dolphins, acoustic signals may well be more important than visual ones. Studies by David and Melba Caldwell and by Peter Tyack and Laela Sayigh, of Woods Hole Oceanographic Institution, point to a system of whistle communication that is highly dependent on learning. In addition to developing its own whistle, each dolphin learns to recognize its mother's whistle and those of others in its group. The reunion of Hannah and her young son described at the beginning of this article is just one situation in which whistling helps the dolphins identify and find one another. The dolphins appear to use these whistles to maintain contact, when socializing, when meeting other dolphin groups, and perhaps to coordinate school activities. For example, whistles are often heard when groups change direction or activity.

Bottlenose dolphins maintain an interest in their kin for much of their lives. The birth of a new calf, for example, often results in visits by older siblings. The first time we found Ms. Mayhem with her newborn son in 1987, she was also accompanied by her fourteen-year-old son, the Kid, who otherwise rarely interacts with his mother, and her four-year-old daughter, Pumpkin, who had recently separated from her mother. We have observed babysitting by older sisters, by other band members, and in one case, by Puka Fin, at thirty-nine years of age the oldest known-age male in the community. In the case of Puka Fin, preliminary genetic findings suggest he may have been the father of two of the three youngsters in the group.

On average, male and female calves tend to remain with their mothers for similar periods of time and reach similar sizes by the time of separation, although males eventually grow significantly larger than females. The parting of mother and young may be gradual or abrupt. Daughters seem to leave somewhat more gradually, returning to their mother's band more frequently during the period of separation than do sons. Newly independent dolphins join roving groups of other youngsters, ranging in age from about three to thir-



Two calves, below, leap side by side, a favorite pastime that helps cement their social connection.

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teen years. Members of these groups are responsible for most of the socializing we see in the wild, including leaps and other acrobatics, much physical contact, and both heterosexual and homosexual interactions. The dolphins may be establishing who is dominant to whom. Males form long-lasting pair bonds during this period. These pairs are often composed of males of similar age that grew up in the same band. Some males remain together for at least ten to fifteen years. Members of these pairs are nearly inseparable. They often swim side by side, in close synchrony. If a member of a pair is lost, he is not easily replaced.

As males mature, they travel widely from one school of females to another, spending very little time with any particular female or her offspring. Bottlenose dolphins in the Sarasota area apparently do not develop long-term monogamous relationships. Duffield's preliminary genetic analyses indicate that subsequent calves of a given female may be sired by different males. We are now doing chromosomal analyses and DNA fingerprinting

in an attempt to identify the fathers. Once we can match fathers up with their offspring, we can better interpret interactions between them, but we do not expect the test results to change our strong conclusion that a mother's investment in a calf greatly exceeds that of the father. And a mother's involvement with her daughters may never end, since when a young female has her first baby, she often rejoins her mother's band and raises her calf in the company of other females with calves of similar age.

We hope that some of what we have learned about Sarasota's wild dolphins may be used to benefit dolphins everywhere. Knowledge of mating systems and rearing patterns, for example, should lead to improved captive-breeding programs. Increased success in such breeding programs should, in turn, reduce pressures to remove individuals from the wild for captive display. As our understanding of the animals improves, our ability to recognize their needs in the face of ever-increasing human alteration of their habitat should also grow. □