

Cooperative Science Services, LLC Dolphinfish Research Program

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A High-Performance Fish

Yellowfin and skipjack tuna are two highly migratory species that share many characteristics. They are world wide in distribution, voracious predators, and known for their fast rates of growth. Studies have shown that their gills possess large surface areas with thin blood-to-water interfaces, a physical feature that permits high oxygen diffusion capacity, supporting elevated metabolic rates. Dolphinfish share these same behavioral and physiological high-performance characteristics exhibited by the tunas and billfishes. Physiological studies have shown that yellowfin and skipjack have a high metabolic rate that supports their high-speed travel and rapid growth. These studies have also found that the common dolphin's metabolic rate is comparable to those of yellowfin and skipjack tunas.

To support such an elevated metabolic rate requires large volumes of food and fast digestion of that food. Food habit studies conducted in the Caribbean, off Florida and North Carolina have shown dolphin to feed on a wide range of organisms. They have been found to eat squid, rock shrimp, crabs, seahorses, puffer fish, ballyhoo, jacks, sardines, other dolphin, tunas and even juvenile sailfish and marlins. Prey importance was found to vary by area. Many of the prey animals are known to live in the upper water column near the surface but some spend their lives at great depths. These studies revealed that dolphin are opportunistic feeders, eating whatever baitfish are available at that time in that area. These studies along with similar research in the Pacific and Indian oceans found the species to have a common fondness for two food forms: flying fish and squid. This

is no surprise to any angler who has checked a few dolphin stomachs.

For a long time science believed that dolphin were visual feeders, limited to feeding only during daylight. Feeding studies conducted in the Pacific and Indian Oceans found that dolphin fed during both day and night, exhibiting two distinctly different prey groups. Stomach fullness of these dolphinfish and the degree of digestion of the food items indicated that day-night feeding periodicity varied by area and may be a function of how fast the prey digested and energy content of the prey. Squid were found to digest faster than flying fish or tunas but provided less energy per given volume. A study of Pacific dolphin suggests that their rate of digestion would be faster than most fish, equal to yellowfin tuna and consistent with other high-performance fishes like tunas and billfishes.

Dolphin are known to eat rather large prey for their size. A good example is the current South Carolina state record dolphin, a beast that measured 57.7 inches in fork length, weighed 77.5 pounds, and was found to contain a five pound, 25-inch fork length cow dolphin in the early stages of digestion. This bull had eaten a fish nearly half its own length, and far larger than the normal size of most prey eaten by dolphin. A Pacific study observed that dolphin would consume prey that ranged from 1.4 to 72.0 percent of their own body length. The average prey size was 17.4 percent of the dolphin's length. In the case of the South Carolina record fish, this would be a 10-inch fish. Such exhibitions of gluttony by dolphin are well known among anglers. The South Carolina state record dolphin pounced on a twelve-pack ballyhoo bait even though the tail of the five-pound dolphin in its stomach

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protruded from its mouth.

In one laboratory rearing study, young dolphin were reported to consume as much as 20 percent of their body weight in food each day. In human terms that would be a 150-pound man eating 30 pounds of food a day. This is the extreme. Researchers estimate the average consumption rate for dolphin at 5.6 percent of the fish's body weight per day. Broken down by sex, area, and length class, daily rations ranged up to 9.6 percent for large males and up to 19.8 percent for small schoolies. Because common dolphinfish occur in large numbers, they likely exert substantial predation pressure on important prey groups. It is safe to conclude that their feeding ecology provides important clues to the pelagic food web and ecosystem structure.



A close examination of the mouth of this 77.5-pound state record dolphinfish will reveal the protruding tail of a 25-inch, 5-pound cow dolphin which did not slow up the bull from eating a 12-pack ballyhoo, showing the glutinous behavior common to the species. Photo courtesy of SC DNR.

This large food intake and rapid digestion fuels the dolphin's fast swimming speeds, providing the energy for their amazing aerial displays and long-distance migrations. It also provides for one of the fastest growth rates known among fish. Age and growth studies report that by 12 months of age dolphin reached lengths of 47.2 inches in fork length and 27.6 pounds in Hawaii and weights of 40 pounds in the Caribbean.

Dolphin grow to a moderate size compared to other highly migratory game fish. The International Game Fish Association lists an 87 pound bull caught off Costa Rica as the all tackle world record. Researchers have regularly reported fish of 40 to 60 pounds among specimens in

their samples. The largest fish are normally bulls (males) with females (cows) seldom exceeding 40 pounds. One of the largest females noted was a 43.5 pounder that measured 50.5 inches in fork length, caught off Puerto Rico. A cow dolphin measuring 50 inches in fork length was caught November 2011 off the Florida Keys and reported to weigh 50 pounds. This could represent the upper limit for females. However, a bull caught off Panama in 2010 that was weighed on a hand-held scale was reported to tip the scales at 60kg, 132 pounds, indicating that dolphin do exceed 100 pounds in size.

Several small, short-term growth-rate studies have been carried out in North Carolina, Florida, Gulf of Mexico, Caribbean Sea, and Hawaii. These studies reported a wide range of results based on method used to determine age (scale versus otoliths) and whether the subjects were laboratory raised or wild stock. There are other factors out of the control of researchers that influence dolphin growth. Two major ones are temperature of the waters dolphin occupy and the availability of food. Cool waters and low food abundance tends to stunt growth. These factors can vary year to year. Two studies also indicated a difference in the growth rate between small and large fish.

Early age and growth studies that used scale annular rings to age the fish reported much slower growth rates than more recent research that counted growth rings in the otoliths (ear stones that are analogous to our eardrums). Depending on the study, small fish were classified as those less than 27.5 inches FL, 35.4 inches FL or less than six months of age.

Researchers reported growth rates for small wild fish from 3.19mm per day up to 4.71mm per day in length. This translates to weekly growths ranging from 0.88 to 1.30 inches in length. Overall, these studies indicated a growth rate of just over one inch per week (3.88mm per day and 1.07 inches per week) for small wild fish. Laboratory-reared fish show a broader range of growth rates, from 1.07mm per day to 5.88mm per day. Weekly growth rate for these lab specimens would range from 0.29 to 1.62 inches per week. However, when an average of these growth rates is taken, the results, 3.78mm per day and 1.04 inches per week, is nearly the same as for the wild fish.

Growth rates of small wild fish using otoliths to age

Location	mm/day	in./week
Barbados, 1983	4.71	1.298
Puerto Rico, 2000	3.59	0.992
Gulf of Mexico, 1988	4.15	1.144
North Carolina, 2008	3.78	1.040
Hawaii, 1986	3.19	0.880

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Growth rates observed for laboratory fish

Location	mm/day	in./week
North Carolina, 1975	1.07	0.29
North Carolina, 1977	5.88	1.62
Florida, 1961	4.80	1.32
Florida, 1971	5.28	1.46
Florida, 1983	3.03	0.84
Hawaii, 1981	3.56	0.98
Hawaii, 1986	2.82	0.78

It is common among animals that the young grow at a faster rate than older individuals and fish are no exception. Two age-growth studies dealing with wild stocks indicated a slower growth rate for the larger, presumably older, individuals. A study in the Gulf of Mexico observed a growth rate of 0.49mm per day for dolphin more than 35.4 inches in fork length, which indicates a weekly growth of 0.14 inch per week. A study conducted in Barbados reported that fish from 27.5 to 43.3 inches in fork length grew at the rate of 1.43mm per day or 0.39 inches per week.

A basic precept is that cultured fish are provided a larger amount of food than they would capture in the wild. For this reason cultured fish normally grow much



This trophy fish demonstrates the rewards of releasing small dolphinfish. Tagged off the Florida Keys as a 16-inch schoolie barely weighing 1.5 pounds, the bull grew to 38 inches during its 205 days of liberty, gaining 20 pounds before its recovery.

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faster than the wild stock. However, knowing that dolphin feed both day and night and that the researchers may not have taken this into account, the result could be that the lab fish were getting only a normal level of food, not an elevated amount of groceries. The fact that the average growth rates observed for fish in the wild as well as in the laboratory were virtually identical could indicate that a growth rate of one inch per week is a valid level.

So what does this high-performance growth mean to fishermen? Utilizing the information gained from length and weight data collection, we see that dolphin 18 to 30 inches in fork length put on an average of 9.3 ounces of body weight per inch of growth. This would mean that for every two weeks that the small dolphin you released survives, it will gain more than a pound in weight. It means that the 17-inch schoolie tagged and released in the Florida Keys could grow to a tackle-testing 40-inch bull before it is recaptured eight months later off Miami.

Dolphin are amazing high-performance fish.

Record dolphin by state

State	Weight (lbs)	Year
Massachusetts	61.19	2009
New York	52.00	1985
Connecticut	no listing	
New Jersey	63.19	1974
Rhode Island	no listing	
Maryland	67.50	1985
Delaware	52.00	2003
Virginia	71.50	1991
North Carolina	79.00	1993
South Carolina	77.50	2008
Georgia	67.38	1997
Florida	81.00	2007
Alabama	65.50	2007
Mississippi	62.00	1981
Louisiana	71.25	1976
Texas	65.70	2008
California	66.00	1990
Hawaii	82.00	1987

For More Information, Contact

Don Hammond
Cooperative Science Services, LLC
961 Anchor Rd., Charleston, SC 29412
Telephone – FAX (843) 795-7524
Email CSSLLC@bellsouth.net
Web site www.dolphintagging.com

