Passage IV

NATURAL SCIENCE: This passage is adapted from *Great Waters: An Atlantic Passage* by Deborah Cramer (©2001 by Deborah Cramer).

Relative newcomers to the marine world, bluefin tuna and swordfish have evolved into some of the sea's most highly developed fishes. While the cod, haddock, flounder, and plaice who dwell year-round in the North Sea and the Gulf of Mexico are cold-blooded, their body temperatures rising and falling in synchrony with the surrounding water, thus limiting their geographic range, swordfish and bluefin, exquisitely adapted to live in the vastness of the sea, are free from the boundaries imposed by temperature. The swordfish who surface at the shelf edge have swum up from the depths, rising hundreds of feet through the water each evening as the sun sets, following their prey of fish and squid. A temperature difference of 36 degrees Fahrenheit, as great as the swing between winter and summer, night and day, separates cold deep from warm surface. Swordfish exit one realm and swim into the other in under an hour.

Moving between such extremes would stun the nervous system of a cold-blooded fish, but these ocean princes make their own heat, warming themselves in the deep cold. The burner of the swordfish lies behind its eyes, below its brain, a dark mass of tissue surrounded by insulating fat, heavy with blood, and loaded with energy-producing mitochondria. With warm brain and eyes, swordfish can chase their food in waters deep and shallow, near and distant. By night, they feed at the surface, at the edge of the deep water. By day, they move onto shallow banks, like Georges or the Grand Banks, and dive down to feed, slashing through schools of menhaden and mackerel with their long, sharp swords.

Bluefin tuna thrive in waters as cold as 40 degrees Fahrenheit and as warm as 75 degrees Fahrenheit but unlike swordfish, they do not possess organs whose chief function is to produce heat. Instead they retain the heat they generate swimming. Other bony fish quickly lose their heat to the sea, for their red muscle lies near their skin, close to the cold water. In bluefin, who can weigh as much as 1,000 pounds, red muscles are housed deep within the body, near the backbone. Warm venous blood flowing away from muscles heats cold blood coming in through the arteries, enabling bluefin to retain 98 percent of their body heat, giving them free rein to forage in cold waters and to dip in and out of the Gulf Stream, where sea temperatures plummet as much as 27 degrees Fahrenheit across one nautical mile. In cold water, the bluefin, separated from the chill by only a taut skin, maintains an internal temperature of 80 degrees Fahrenheit.

Coincident with the relocation of its red muscle, bluefin developed the unique style of swimming for which they are so aptly named (*Thunnus thynnus,* from the Greek meaning to dart or lunge forward). While the bodies of other fish undulate through the water as they swim, the crescent-shaped tail of the bluefin propels its rigid body forward. Retractable fins, small scales, and recessed eyes further enable bluefin to thrust quickly through thick and heavy seas, easily overcoming water's drag and resistance. With their warm bodies, rapid metabolism, and sleek design, bluefin excel at both short sprints and long-distance travel. They zoom in on prey in short, quick bursts of speed, and they can cruise at two body lengths per second, easily making long-distance endurance swims along an entire ocean basin. Engineers who design underwater robotics dream of replicating the sleek body of this 8-foot-long, 700-pound fish who rushes without ceasing through the breadth and depth of the sea.

Swordfish and bluefin travel throughout the Atlantic with tremendous speed, but from moment to moment, day to day, month to month, their migrations are not well charted. In the winter of 1997, when the warm Gulf Stream edged shoreward toward the coast of Cape Hatteras, pressing against cold water rushing south in the Labrador Current, giant bluefin gathered in the warmth along the boundary. The following year, when the Gulf Stream moved offshore and the chilly Labrador Current filled the waters of coastal Cape Hatteras, bluefin wintered in waters unknown to people. Some bluefin, fattened in American coastal waters during the summer and fall, follow the currents across the sea during the winter. How they navigate, no one really knows. They could be guided by internal compasses of magnetite chips embedded in their skulls, by the warmth, salinity, or motion of the current, by patterns of polarized light received by the pineal window in their heads, or by prey leaving their scent as an oily, odorous slick in the water.

31. The main purpose of the passage is to:

- **A.** propose that research be conducted to confirm which navigational method swordfish and bluefin actually use.
- **B.** persuade the reader that swordfish are superior to bluefin in their adaptation to ocean life.
- **C.** speculate on the reasons why two fish have developed certain specialized traits.
- **D.** describe two fishes' adaptations to the ocean environment, including specialized traits and physical features.

32. The author's attitude regarding swordfish and bluefin can best be described as one of:

- **F.** appreciation for the advanced, unique abilities of the two fish.
- **G.** concern that their adaptations put other fish at a disadvantage.
- **H.** confusion over how their adaptations evolved so quickly beyond other fish.
- **J.** neutrality when comparing their abilities to those of other fish.

33. The passage indicates that the body temperature of a cold-blooded fish is primarily determined by the:

A. limits of its geographic range.
B. speed at which it swims.
C. type of prey it consumes.
D. temperature of its surrounding water.

34. According to the passage, the most significant difference between the temperature-regulation systems of swordfish and bluefin is that swordfish:

F. generate heat from a specialized organ, while bluefin retain heat generated from swimming.
G. have a heat-producing organ located behind their eyes, while the bluefin's is near its backbone.
H. retain heat generated by mitochondria, while bluefin retain heat generated by ocean currents.
J. retain most of the heat they generate, while bluefin lose most of the heat they generate.

35. It can reasonably be concluded from the passage that the body of a bluefin remaining rigid while swimming is related to the fact that its red muscles are:

A. moved sparingly in order to conserve body heat.
B. frozen stiff from the icy-cold water of the ocean.
C. restricted from movement by its super-tight skin.
D. located deep within its body near the backbone.

36. It can most reasonably be inferred from the passage that the waters in and near the Gulf Stream pose a challenge to most species of fish primarily because these waters:

F. are home to a large number and variety of predators.
G. represent a wide range of temperatures.
H. contain strong and swirling currents.
J. force fish into unfamiliar ocean regions.

37. According to the passage, the Greek-derived name for bluefin refers to the:

A. bluefin's constant internal temperature.
B. powerful crescent-shaped tail of the bluefin.
C. bluefin's lunging swimming style.
D. sound the bluefin produces while swimming.

38. The main purpose of the last paragraph is to:

F. explain that charting the Gulf Stream would help accurately predict the migration patterns of swordfish and bluefin.
G. highlight the fact that researchers do not yet fully understand the migrations of swordfish and bluefin.
H. reiterate that the territory of swordfish and bluefin is the entire Atlantic Ocean.
J. remind the reader of the speed and depth at which swordfish and bluefin travel.

39. The passage supports the idea that all of the following fish dwell in the North Sea and the Gulf of Mexico year round EXCEPT:

A. cod.
B. haddock.
C. plaice.
D. bluefin.

40. According to the passage, the heat a swordfish generates is primarily intended to:

F. attract cold-blooded prey seeking warmth.
G. maintain the warmth of its eyes and brain.
H. increase its speed by keeping large muscles warm.
J. strengthen its long, sharp sword with warm blood.

END OF TEST 3

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO A PREVIOUS TEST.