T11.14 MARINE FISHES

Fish is the most abundant and diverse group of vertebrates in the ocean, with 538 species recorded in the Canadian Atlantic Region alone.[1] Three main classes or groups of fishes are represented in Nova Scotia waters: the jawless fishes (Agnatha), including the Sea Lamprey and the hagfish; the cartilagenous fishes (Chondrichthyes)—the sharks and rays; and the bony fishes (Osteichthyes). The latter group contains most of the local species.

The familiar commercial species of marine fish in Nova Scotia make up only a small proportion of the total number of species. Numerous lesser-known but occasionally abundant species inhabit the various marine and estuarine habitats.

The largest fishes include the Basking Shark, the second-largest shark species in the world (after the Whale Shark), and the White Shark, which has been recorded at over 11 m in length at the mouth of the Bay of Fundy.[1] The smallest species are probably the various species of sticklebacks found in shallow areas along the shore, and the lumpsuckers and tadpole-like snailfish, which live among bottom rocks and algae. These species reach maximum sizes of 3 to 10 cm.

DISTRIBUTION

Marine fish have definite patterns of distribution, linked to a variety of factors, including water temperature, bottom type, depth and water-column productivity. Shallow marine environments are used as nursery areas for larvae and juveniles of many fish species. Distributions often change predictably with seasons in response to environmental factors such as water temperature or food availability. For example, many of Nova Scotia's herring overwinter in dense schools in Chedabucto Bay (Unit 911) in eastern Nova Scotia and move to waters off southwest Nova Scotia and the mouth of the Bay of Fundy (Unit 912) in summer to feed and spawn. Cod, haddock, pollock and Silver Hake spawn primarily on the offshore banks, while American Plaice and redfish spawn widely over the shelf.

Fisheries scientists have identified distinct geographic groupings, known as stocks, of most commercial species. By analogy, stocks are like massive herds of terrestrial animals such as Reindeer or Caribou. Stocks are defined as groups of organisms usually separated geographically and in other ways from other stocks of the same species, and in which there is little if any interbreeding. Stocks are managed as individual units, and many of the offshore fishing zones were established to encompass particular fish stocks.

The abundance of a fish species relates to unpredictable physical and biological conditions which influence the success of a particular year's young—known as a year class. Periods of high abundance usually follow a period, several years before, when conditions favoured survival and maturation of young. In such cases, periods of abundance in the fisheries typically have been followed by stock "collapse". Stocks may rebound from collapse if measures to manage the fishery are put in place, but recovery is never certain.

Many species (including some that are commercially important) live in estuaries, in other coastal waters and even in fresh water for part of their lives. Species that spawn and undergo early development at sea and live mostly in fresh water are classed as catadromous. Those that spawn in fresh water and spend varying proportions of their lives in coastal or offshore waters are classed as anadromous. In either case, the move requires a major change in the physiology of the fish to adapt to changes in salinity.

The line between freshwater and marine fishes is not always easy to draw, as certain species move freely between both systems. The marine fishes likely to be found in Nova Scotia's coastal waters may be divided into five groups:

1 small fishes of estuaries and tidal inlets
2 groundfish
3 pelagic species
4 mesopelagic species
5 exotic warm-water and eastern-arctic species

Fishes in the first group depend on the types of intertidal and subtidal habitats available. The concentrations and movements of the other groups relate to temperature, salinity, bottom characteristics and food resources—factors which are closely dependent on the movements of the major water masses in the northwest Atlantic and on the bathymetry of the continental shelf. Generally speaking, the shallow-water environments offer more opportunities for specialization and therefore have high species diversity. Further offshore, the species diversity is lower but the

biomass is high—the feature on which the great fisheries of the Atlantic coast are based.

ESTUARINE FISH

Up to twenty fish species are commonly found in Nova Scotia's estuarine systems. They include fishes that remain in estuaries for their entire life cycle or leave for only a short period to spawn in fresh water. The young, on hatching, flush immediately back into the sea.

Anadromous fishes that pass through estuaries on their way to spawning grounds in fresh water include Gaspereau, Atlantic Salmon and American Shad.The spring migrations of Gaspereau and shad are the highlight of seasonal fisheries in many areas of Nova Scotia. Some of these species are known for their long migrations. Atlantic Salmon from the Maritimes can reach waters off Greenland before returning to spawn, while a large proportion of American Shad, which spawn in rivers along the entire North American east coast, spend the summer feeding in basins in the Upper Bay of Fundy (Unit 913). Both Atlantic Salmon and Rainbow Smelt (American Smelt) can adapt to life strictly in fresh water and become "landlocked" in some cases.[2]

Winter Flounder, Striped Bass and Atlantic Sturgeon use the upper estuary for spawning, and their young may spend several years using estuaries as nurseries before migrating to the sea.

Species which typically occur in fresh water (such as Brown Trout, Brook Trout and four species of stickleback) often exploit coastal estuaries during parts of the year because of the abundance of food and sometimes favourable temperatures. Many freshwater species are able to take advantage of the productivity due to the presence of a freshwater wedge (see T6.4). In some estuaries, this wedge can extend a considerable distance downstream. The juveniles of many commercial demersal and pelagic fishes, such as cod, pollock and herring, also feed in coastal environments.

The American Eel is the only catadromous species in North America, reproducing at sea in the mid-Atlantic Ocean (Sargasso Sea). The young transparent glass eels, or elvers, are carried to Nova Scotia waters by ocean currents and enter streams and lakes, where they live for five to ten years before a fall migration takes them to the sea to spawn.

Coastal and estuarine habitats can offer abundant food resources, but fish diversity is often restricted by the less-hospitable environment. Fish must be tolerant of strong currents and fluctuating temperatures and salinities. Tidal marshes, and rockweed and Eel Grass beds are important components of the estuarine and coastal environment. Few animals feed directly on the living plants; instead, the food chain begins with decaying plant remains or "detritus". Detritus and dissolved nutrients washing into the coastal zone promote a "pulse" of increased production by microscopic plants and plankton organisms, as well as in the community of epibenthic (near bottom) detritus-grazing organisms (mysids, sand shrimp, etc.). These in turn supports the juvenile and adult fishes that occur in coastal and estuarine habitats.

GROUNDFISH

Groundfish (included with the demersal fishes) can occur offshore as well as in coastal inlets and estuaries. Groundfish species include cod, flatfishes (e.g., flounder, plaice, halibut), redfish, haddock, pollock and hake. These species usually have egg and larval stages which drift with ocean currents and settle to the seabed. They live close to the bottom for much of their adult life. The Winter Flounder is one of the best-known inshore marine groundfish species, whose survival in cold inshore waters even in winter is thought to be due to "antifreeze" proteins in its blood.[1] Some species, such as the Witch Flounder and the Atlantic Halibut, are found at great depths (Witch Flounder prefer the gullies between offshore banks where the bottom is clay, muddy sand or pure sand, while halibut prefer areas with a hard bottom of rock, sand, clay or gravel).[3] The Windowpane Flounder is commonly found in the inner Bay of Fundy, particularly as juveniles in tidal channels and mud-flat areas.

All groundfish are carnivores, feeding on benthic invertebrates, such as worms, molluscs and crustaceans, and on other fish, but each type of groundfish shows feeding specializations. Flatfish live near the bottom and feed on invertebrates, particularly polychaete worms. The mouths of many of the flatfish species are small and oriented side-ways, enabling them to "snip" off worms sticking out of the bottom. Gut contents often include the feeding tubes ("siphons") of clams that protrude from the surface. Atlantic Cod will eat almost anything; the species was traditionally caught by "jigging" with a shiny, multi-hooked lure dangling near the bottom. Cod frequently catch crabs, small fish, worms, clams and snails, stones (from which they digest the attached anemones and other organisms) and litter. Species such as pollock (known commercially as "Boston bluefish") that move further up into the water column in large schools can capture some of the more mobile organisms: herring, juvenile cod,

haddock and hake, as well as shrimp and squid.[4] Silver hake are viewed as a pest by some because, in addition to krill and other zooplankton, they consume the larvae and juveniles of other commercial fish species.

Patterns of Movement

All species of groundfish move in response to water temperature, and the changing temperatures in the offshore lead to particular seasonal movements. For example, Atlantic Cod on the Scotian Shelf (Region 900) prefer cool temperatures; however, preferred temperatures are influenced by time of year, geographic locations, and size of fish. On the Scotian Shelf, they prefer 3–4°C on the northeast and 7–8°C on the southwest.[1] They spawn in March and April over offshore banks and move towards shore in the summer. Although the cod move locally, there are four main areas of concentration: a Nova Scotia coastal stock, a Browns–LaHave Bank stock, a Georges Bank stock and the Banquereau–Sable Island stock (Unit 931).

In the Gulf of St. Lawrence, cod spawn on the Magdalen Shelf and move eastwards to overwinter on the southern edge of the Laurentian Channel off Cape Breton Island (Unit 932). Silver Hake, a groundfish important in fisheries at the edge of the Scotian Shelf, has a preferred temperature range of 6–8°C and moves into shallower waters as temperatures warm during the season.[1] Red Hake from the Gulf of Maine migrate into Passamaquoddy Bay on the New Brunswick side of the Bay of Fundy, but hake on the central Scotian Shelf do not appear to make significant inshore migrations, since the temperature is within their preferred range there year round.

PELAGIC FISH

Pelagic fish travel mostly in large schools, feeding mainly in surface waters or middle depths. Schools of pelagic fish are renowned for their ability to turn and manoeuver in close formation with split-second timing.[5] Pelagic fish are generally streamlined and have protective coloration, usually blue or blue-gray over their backs and silvery white underneath. Key pelagic species in marine waters are herring, mackerel, swordfish, Bluefin Tuna and Capelin, as well as many of the nearshore and estuarine species.

Pelagic species generally feed on zooplankton and smaller fish species. Herring and mackerel feed on planktonic crustaceans and fish eggs and larvae, and may also filter with their gillrakers when food is suitable.[6,7]

Patterns of Movement

Pelagic species (herring, tuna, mackerel) are some of the most migratory of fish. In a year, herring schools easily move along the entire Atlantic coast of Nova Scotia. Bluefin Tuna spend the winters in warm southerly waters and move northward to Nova Scotia as the season progresses, the smaller tuna arriving before the big ones, first at the Scotian Shelf and finally reaching the Gulf of St Lawrence. Mackerel approach the Atlantic Coast in late May in large schools and leave again in the fall for overwintering areas off the shelf edge of the eastern United States.

MESOPELAGIC SPECIES

Mesopelagic species live on the Continental Slope (District 940). They include lanternfish and Myctophids. One feature of many of these deepwater species is their vertical migration towards the surface at night. The fish therefore have to be able to withstand drastic pressure changes. Although mesopelagic fish are themselves unlikely to be seen in inshore waters, they are of interest because they constitute an important food resource for seabirds such as Storm Petrels.

EXOTIC WARM-WATER AND EASTERN-ARCTIC SPECIES

The coastal fish fauna of Nova Scotia is much enriched by a variety of exotic visitors. Many are associated with warm water brought in by currents from the continental slope. They often move in as juveniles and spend the summer in tidal inlets, taking advantage of the warmest surface temperatures between August and November, but cannot survive the winter. Studies in St. Margarets Bay and Prospect Bay (Districts 460, 850, 910) produced a collection of thirty-one species from warmer waters. These fish include flying fish, seahorses, Priacanthids and mullet. Several species of shark can also be associated with this group, including the Dusky, Silky, Whitetip, Hammerhead and Mako—all of which occur in the warm waters of the Gulf Stream. In addition, several species of eastern-arctic origin, such as the Greenland Cod, Mailed Sculpin and Arctic Eelpout, have been recorded from cold-water areas on the banks and eastern shore.[8]

LIFE HISTORIES

Fish reproduce by means of eggs laid by the females and fertilized by males, but many different strategies have evolved for egg survival. Many of the groundfish species, such as cod, lay millions of spherical eggs which float to the surface of the water. Upon hatching, the young fish larvae feed on zooplankton and remain near the surface until they are large enough to live near the bottom. The larvae are weak swimmers and drift with prevailing currents, but current patterns can keep them in certain areas (usually the shallow offshore banks but also in some estuaries) throughout development.[9] The eggs of some species (e.g., herring) sink and stick to objects on the bottom, such as rocks and algae. The young live in shallow coastal waters near the site of spawning. Redfish, a species found from near bottom to mid-water in deeper waters, gives birth to fully formed young. Species such as skates and hagfishes have large, tough egg cases. The brown, leathery, H-shaped egg purses of skates frequently wash up on Nova Scotia's beaches. Like Redfish, the Spiny Dogfish, a species common in coastal waters in the summer, gives birth to fully developed young. The 22- to 24-month gestation period is the longest of any vertebrate.[5]

Fish are food of higher vertebrates, including birds and sea mammals, and the young stages are heavily preyed upon. Of several million cod eggs laid by each individual, only one survives to reach adulthood.

In turn, fish feed on other organisms. Specific feeding habits and adaptations relate to particular constituents of the diet. The mouths of flatfish are well suited to capturing marine worms, smaller invertebrates and fish on the sand-to-mud bottoms where they live. Cod have large mouths which can engulf a wide range of bottom-dwelling prey. Rays, flounders, cod and sculpins will eat whole clams or sometimes just nip off their siphons. Pelagic species feed on zooplankton and small fish, and are adapted for speed and quick movements.

Juveniles of Red Hake and a species of snailfish use live sea scallops as shelter. These species wriggle into the internal cavity of the scallop, emerging to feed at night, and have no apparent ill effects on the scallop. The snailfish uses its ventral sucker to attach itself to the upper half of the shell. Juvenile haddock hide amid the poisonous tentacles of the Lion's Mane jellyfish, apparently not sustaining injury.[10]

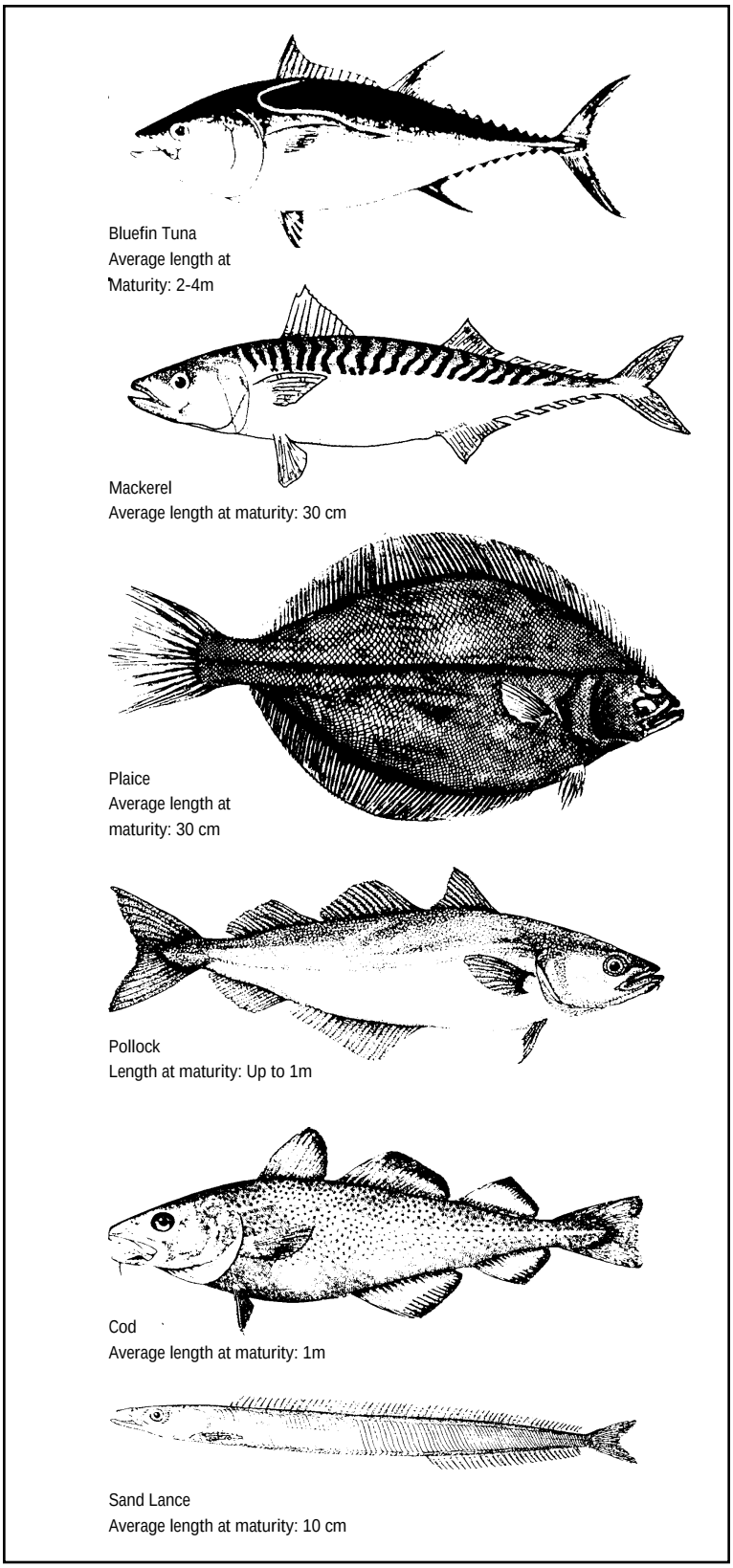

Figure T11.14.1: The general shapes of marine fish.

FORM AND FUNCTION

Fish have evolved in physical structure and behaviour to take advantage of the various food sources available in the sea, the kinds and distribution of habitat, and to the physics of the dense, watery medium in which they live (see Figure T11.14.1).The shape of a fish is a clue to its life style.

Among pelagic species, highly streamlined fish (typified by the mackerel and Bluefin Tuna) specialize in catching moving prey (small fish and zooplankton). They have a pair of pectoral (front) fins which can be held out at slow speeds to act as hydroplanes but which are withdrawn when the fish needs a burst of speed. They also lack swim bladders, which in many species provide added buoyancy. The tuna is another streamlined species which relies on speed to catch larger fish and squid. Tuna were originally classed in the same family as mackerel (the Scombridae) but now occupy a separate family, the Thunnidae. The energetic muscle action and design of the circulatory system in the tuna allows it to maintain its temperature up to 15 degrees Celsius above water temperature.[1]

Demersal species are much less streamlined. Among these species, the group known as flatfishes have lost the ability for prolonged swimming. These species, which include the commercially important Atlantic Halibut, Winter Flounder, American Plaice and Yellowtail Flounder, as well as several less-common species, start out life resembling other species and swimming in the water, but undergo a remarkable change to enable them to assume an adult life style. The eye from one side shifts to the other, as other changes in body structure take place, enabling them to lie flat on the bottom. Flatfish also typically have a protective colour pattern on the top side (pale beneath) which matches the seabed.

One of the most unusual, although common, species is the Monkfish. Found in shallow coastal waters, this camouflaged species has a lure ressembling a small fish which it wiggles above its head and engulfs prey (which can even include sea ducks and seabirds) with its gaping mouth and razor teeth. Several species of lumpfish, lumpsuckers and snailfish (found in rocky or coarse habitats near shore or on the offshore banks) have a sucker on their ventral side for clinging to stones or shells.

Fish such as pollock are pelagic species similar in general form to cod, but they spend much of their adult life in middle layers of the ocean. They are more streamlined than wholly demersal species such as cod.

The pencil-shaped Northern Pipefish, a member of the seahorse family, is common in beds of seaweed and Eelgrass in shallow coastal waters, and even seahorses occasionally enter Nova Scotian waters. The circular mouth of the Sea Lamprey is used to attach to prey species of fish.

An extreme adaption is the elongate shape of the Sand Lance which helps the up-to-30-cm-long individuals burrow into sandy bottoms on offshore banks and nearshore areas. Sand Lance larvae are the most abundant and widespread fish larvae in the northwest Atlantic early in the year.[11]

CULTURAL FACTORS

Most of the commercial fish stocks have faced overfishing at some time or another. Many key species and stocks, the most notable being the Atlantic Cod, are in trouble. Newer fishing methods and more effective gear have time and again resulted in a cycle in which fish catch has increased to a peak, and then dropped off, with disastrous consequences for local economies.

The groundfish fisheries of Nova Scotia were important in early commerce, and one of its symbols, the *Bluenose*, was built to ply the rich fishery (also for that reason Atlantic Cod has been called "Newfoundland currency"). Fish are a staple of the Nova Scotia economy and a fishing culture encompassing a wide range of fishing techniques, traditions and seasonal activities has been in existence for centuries.

Associated Topics

T6.2 Oceanic Environments, T6.3 Coastal Aquatic Environments, T6.4 Estuaries, T11.7 Seabirds and Birds of Marine Habitats, T11.12 Marine Mammals, T12.11 Animals and Resources

Associated Habitats

H1.1 Open Water, H1.2 Benthic, H2.5 Tidal Marsh, H3 Fresh Water

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