M.Sc. (Final) Semester –IV (Zoology)
Paper III (a): Fishery Biology- Taxonomy and ecology of Pisces

Pollutant affecting Fishery water with special reference to Oil Spills

Oil pollution does come from oil spills from large tankers, but there are other sources of oil pollution that, collectively, discharge more oil into water than the major oil spills do.

Sources of Oil Pollution

The United States National Research Council (NRC) published a report in 2002 that said that, globally, approximately 1.3 million tonnes of oil are released into the sea each year. The exact amount of oil pollution varies each year, generally between 470,000 and 8.4 million tonnes, depending on the frequency and severity of oil spills. As well, estimates from credible organizations and scientists will vary greatly, because it is extremely difficult to measure the amount of oil pollution that comes from non-point sources, such as industrial and domestic runoff.

Some oil pollution is actually natural; oil can seep from the bottom of the ocean and from eroding sedimentary rocks. Coal Oil Point, which is several kilometres off of the California coast, releases between 7,500 and 11,400 litres of crude oil each day! There have been about 200 natural underwater oil seeps identified around the world, including off the east coast of Canada, near Labrador and off the north coast of Baffin Island.

Transportation and transfers of oil increase the risk of oil spills; to transport oil from the source to the use, up to 15 transfers may be required between ocean tankers, pipelines, trains and tanker trucks. As the number of transfers increases, so does the risk of spilling the oil.

Routine maintenance includes bilge pumping and other ship operations. Bilge is a mixture of oil and water; each discharge is fairly small, but thousands of releases of bilge into the oceans add up to a large amount of oil pollution. This is one source of oil pollution that is difficult to measure; it is illegal for ships to release bilge into ocean waters, so there are likely many bilge releases that go unnoticed.

Big spills typically account for 5 to 12 percent of total oil pollution that enters the ocean, but oil spills are especially serious because of the heavy concentration of oil in one region. Because oil spills are localized, they can severely contaminate beaches and sediment, and cause serious harm to marine wildlife. Oil spills can suffocate fish, get caught in the feathers of birds and mammals and block light from photosynthetic plants in the water.

WHAT HAPPENS WHEN OIL SPILLS?

There are a number of processes that can occur when oil spills, depending on the water source and the type and amount of spilled oil.

1. The most common effect is the spreading of the oil over the surface of the water. Most oil is less dense than water, so when oil spills, it spreads across the water surface. Oil spreads very quickly, with lighter oils, like gasoline, spreading faster than heavy crude oils. Currents, wind and warm temperatures will cause the oil to spread faster. Typically, oil can spread as thin as a coat of paint very rapidly. For this reason, it is important for oil spills to be contained as quickly as possible.

2. The oil can be moved, with currents, tides and the wind. This can be a significant problem in rivers, because the currents can carry the oil a great distance from its origin. It can also cause substantial damage in oceans, because the tide can carry the oil to beaches and intertidal zones, which are especially sensitive to oil pollution.

3. Natural bacteria can digest the hydrocarbons and convert them to carbon dioxide and water. This is called biodegration, and is a natural process that can clean water and sediment after an oil spill.

4. Some oil will evaporate. Up to 50 percent of the volume of most oil spills can evaporate. Light fuels, such as gasoline, will almost entirely evaporate within one or two days.

5. Natural physical, chemical and biological processes can cause the oil to weather, changing the characteristics of the oil.

6. Oxidation is a chemical reaction that can occur between oxygen and hydrocarbons, and is a natural process that slowly breaks down the hydrocarbons.

7. Emulsification is the combination of two liquids, when one is suspended in the other. Between water and oil, the combination can be water-in-oil or oil-in-water; water-in-oil is a stable mixture and can persist for years. Water-in-oil often consists of 50 to 80 percent water, and the water appears reddish-brown and feels greasy, due to the presence of oil.

WHAT KIND OF DAMAGE DOES OIL POLLUTION CAUSE?

Oil pollution can damage ecosystems, including plants and animals, and contaminate water for drinking and other purposes. The feathers and fur of birds and marine animals can become coated in oil; when the animals are covered in oil, they can no longer insulate themselves against the cold water, and birds have difficulty flying. Furthermore, when the animals clean themselves, they ingest some of the oil. Most birds that are coated in oil would not survive, if it weren't for people cleaning them. So a lot of work goes into cleaning one bird. Fish can be suffocated by the thick sludge of oil on the water surface, and bottom-dwelling fish can develop liver disease, as well as reproductive and growth problems.

HOW IS OIL POLLUTION CLEANED UP?

There are several clean-up methods that can be used, depending on the type and amount of spilled oil, the water location and local weather conditions. Following are a list of some clean-up methods that are commonly used to treat areas that have been affected by oil spills.

Recovery times can range from weeks to decades. Along bedrock shorelines, where there are high-energy waves, the region may recover within several weeks. Exposed beaches generally recover within a matter of months, but marshes and salt flats may take years or even decades to recover from an oil spill. Mangroves, which are coastal regions in the tropics and subtropics, can take around 50 years to recover.

NATURAL METHODS: BIOREMEDIATION

The natural environment can effectively remove contaminants from the water and soil. There are microorganisms that are present in the environment that can break down many harmful chemicals, including gasoline and oil. To increase the rate at which the microorganisms work, nutrients, such as nitrogen or phosphorus, are often added. Bioremediation is a process that occurs, to some degree, after every oil spill. After the majority of the oil spill is cleaned up manually, biological processes break down the trace amounts that could not be removed. Or, in sensitive areas that would cause too much damage if people were to attempt to clean up the oil, these biological processes, together with evaporation, oxidation, weathering and other natural processes, will break down the oil and naturally clean up the environment.

BOOMS

Because oil spreads very quickly, the most important primary step is to contain the spill to as small of an area as possible. Booms are one of the most commonly used tools, because they can contain the oil to keep it from spreading. There are three main types of booms. A hard boom, like the first picture below, is a piece of plastic with a cylindrical float at the top and a weighted bottom, so that it floats on the surface with an underwater “skirt.”

CHEMICAL DISPERSANTS

Chemical dispersants can be successful in cleaning up oil spills. Dispersants are chemicals that are applied to the surface of the water, usually by a low-flying plane. Oil can eventually break down naturally, and chemical dispersants act to speed up the natural process. The oil binds to the dispersant, and is able to move further down the water column, meaning that the oil disperses into the water. The water dilutes the oil to a concentration that is less harmful to aquatic life in the region. The following diagram illustrates how chemical dispersants can be

applied to an oil spill. The red substances are the chemicals that are applied to the region with a low-flying plane; the black substance is the oil that binds to the dispersants and becomes suspended and diluted in the water.
Application of Chemical Dispersants to an Oil Spill
Dish detergent is a common household item that can illustrate how chemical dispersants work, because grease and oil bind to dish detergent and are washed away. However, chemical dispersants are not applied to shallow water near shores, marshes, near coral reefs, or other sensitive areas.

SKIMMERS

Skimmers are boats that can skim oil from the water surface. An advantage of using a skimmer to remove oil from water is that it doesn't change the physical or chemical properties of the oil, as methods such as using chemical dispersants do. Skimmers often have attached settling tanks, so that the oil and water can be separated in the tank. If the oil is relatively fresh, it can be refined. In other instances, the oil is burned. The success of skimming depends on the type and thickness of the oil spill, the amount of debris in the water, the location and the weather conditions (skimming works best in calm weather).

SORBENTS

In addition to using sorbent materials as booms, to contain and soak up oil spills, sorbents can also be applied to the water surface as powders. Sorbents are often the final step of clean-up, because they can absorb trace amounts of oil that could not be skimmed off. Commonly used sorbents include natural organic materials, such as peat moss and sawdust, or synthetic organic materials, such as polypropylene, polyester foam or polystyrene. Sorbents are generally applied by hand, and recovered with the use of nets and rakes.

BURNING

Burning is a method that is often used to remove oil from the surface of the water. Oil may also be burned after skimmers remove the oil from the water surface. The burning of oil releases nitrogen and sulphur, which in turn causes acid rain. While burning can remove the oil from the water surface quickly and efficiently, it causes additional pollution. Thus, there are some ways of cleaning up after oil spills that are more beneficial than others.
Burning an Oil Spill

BEACH CLEAN-UP

Areas near shore that are contaminated with heavy concentrations of thick oil are often cleaned up manually, using shovels and trucks. Manual recovery can also be used to pick up oiled beach sand and gravel, to remove it from the beach and transport it to alternate locations for treatment. Vacuum trucks can vacuum the oil up, right off of the beach. Pressurized hoses can also be used to wash oil off of beaches, into the water, where it will be dispersed and diluted in the water.