Photo: G. A. Morris

STUDY GUIDE 2023

Species at Risk

FORESTS ONTARIO

ONTARIO ENVIROTHON 2023

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Acknowledgements

The following study guide was created by a team of students from the Ecosystem Management Technology Program at Sir Sandford Fleming College. The team is comprised of Courtney Brake, Katelyn Gao, and Benjamin Rops. The purpose of the study guide is to provide high school students with study materials that reflect the 2023 Ontario Envirothon Current Issue Topic.

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Key Ideas & Learning Objectives

KEY IDEAS

1. Biodiversity and its importance
2. Conservation status designations of species at risk
3. Threats that impact species at risk and their habitat
4. Strategies and management actions for species at risk
5. Species at risk governance and stewardship

LEARNING OBJECTIVES

1. Understand and describe the importance of species at risk to biodiversity
2. Define and understand key terms, including species at risk, biodiversity, conservation, and mitigation
3. Identify threats to species at risk,
4. Be able to describe the process of assessing status for a species in Ontario, including categories and criteria
5. Understand the difference between conservation and preservation
6. Understand the role the Endangered Species Act plays in protecting species at risk in Ontario

Tools and Resources

- iNaturalist.ca
    - PictureThis plant identification tool
    - Merlin Bird ID
    - Seek by iNaturalist
- Aquatic species at risk map
- Endangered Species Act – Ontario
- Species at Risk Act – Canada
- COSSARO – Committee for the Status of Species at Risk in Ontario
- Crown Forest Sustainability Act
- Government of Ontario - Species at Risk in Ontario
- Hinterlands Who's Who
- Government of Canada – Species at Risk Education Centre
- ICUN Red List of Endangered Species

1.0 Introduction to Species at Risk

A **species at risk** is commonly defined as any species that is at risk of disappearing from a habitat where they occur naturally. There are many threats that can lead to a species becoming classified as at risk, including habitat loss, habitat fragmentation, pollution or contamination, disease, climate change, and other **anthropogenic** factors.

A **conservation status** is a label assigned to a species to reflect how the wild population of a species is doing. A conservation status designation can act as an indicator for which species need **conservation** action and how quickly these actions need to be implemented to preserve wild populations.

Table 1: A list of status categories used when describing species at risk

STATUS CATEGORY	DEFINITION
SPECIAL CONCERN	A species that may become threatened or endangered because of a combination of biological characteristics and identified threats
THREATENED	A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction
ENDANGERED	A species facing imminent extirpation or extinction
EXTIRPATED	A species that no longer exists in the wild in the geographic region but exists in the wild outside of that geographic region.
EXTINCT	A species that no longer exists in the wild in the geographic region but exists in the wild outside of that geographic region.

In Ontario, there are 264 species at risk (COSSARO, 2022). Occasionally, there are different conservation statuses given to different populations o the same species. These populations may be separated by jurisdiction (e.g. a species may have a different status depending on the province) or geography (e.g. populations o Lake Sturgeon in different waterways across Ontario).

Different organizations such as the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Committee on the Status of Species at Risk in Ontario (COSSARO) assign status to different species based on available scientific knowledge and data.

The classifications made by these organizations rely on a series of criteria, including whether there has been a decline in the number of mature individuals of the species, a decline or **fluctuation** of the species' distribution range, how big the Canadian population of the species is, and what the projected population trends say about the species to assess whether a species is at-risk (Freedman & McAllister, 2021). The number of mature adults in a species affects the number of young that can be produced in a season which impacts the overall population growth or decline. Declines or fluctuations in a species' geographic range can indicate a decrease in the success of a population or a lack of suitable **habitat**.

Once COSEWIC or COSSARO determines whether a species should be federally or provincially protected, they make that recommendation to the Minister of ECCC at the federal level or the Minister of Environment, Conservation and Parks (MECP) at the provincial level in Ontario. The Minister then determines whether there is enough information to add this species to the list or change its ranking within the list, or asks for additional information to be completed to fill in data gaps to make an informed decision.

In June 1992, the United Nations Environmental Program drafted and signed the Convention on Biological Diversity. Canada was one of 168 signing countries that committed to enhancing, restoring, and protecting the biodiversity globally. As part of this Convention, there were three main functions that were identified:

1. Conservation of biological diversity
2. The sustainable use of the components for biological diversity
3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

To meet obligations as a signatory of the Convention on Biological Diversity, Canada enacted its Species at Risk Act in 2003, proposing a framework for the national protection and conservation of species-at-risk (Government of Canada, 2019). The purpose of the first Species at Risk Act was to prevent the **extinction** or **extirpation** of Canadian **native species**, **subspecies**, and distinct populations, to try and recover threatened species, and to advocate for management of species before they become at risk (Government of Canada, 2019). The Act requires that "the best available knowledge be used to define long and short term objectives in a recovery strategy and action plan". The branches of government, agencies, and counsels that were identified to operate under the Species at Risk Act are the Department of Environment and Climate Change, Department of Fisheries and Oceans, Parks Canada, Canadian Endangered Species Conservation Council, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and the National Aboriginal Council on Species at Risk (Government of Canada, 2019).

In Ontario, the Endangered Species Act is the guiding statute that protects species at risk and their associated habitats. It prohibits a person from killing, harming, harassing, capturing, or taking a living member of a species that is provincially extirpated, endangered, or threatened, and also prohibits the damage and destruction of their habitat. The Endangered Species Act was first enacted in 2008 and works similarly to the Species at Risk Act. While the Species at Risk Act only protects species at risk on federal lands, the Endangered Species Act protects species at risk on private and provincial lands throughout Ontario. The Endangered Species Act makes it illegal to possess, transport, collect, buy, sell, lease, trade or offer to buy, sell, lease, or trade any living or dead member of a listed species, or any parts or derivatives thereof.

There are two types of habitat protections under the Species at Risk Act and Endangered Species Act:

1. General Habitat - when species are listed as endangered or threatened, their general habitat is automatically protected

2. Regulated Habitat - a habitat regulation replaces general habitat protection. It provides a more precise definition of a species' habitat and may describe features, geographic boundaries, or other unique characteristics.

Regulated habitats may be smaller or larger than general habitat. It may include areas where the species isn't currently found; however, these areas may have previously been occupied by the species or could be occupied in the future.

In this guide, students will explore the importance of biodiversity and conservation, threats to species at risk, **mitigation** and recovery strategies, and the roles of various governments, non-government organizations (NGO's), Indigenous groups, and individuals in species at risk conservation efforts.

2.0 Threats to Species at Risk

2.1 Habitat Loss & Fragmentation

Habitat loss is the reduction in the quality and/or quantity of suitable habitat that is available to a species. This problem is especially apparent when breeding, feeding, and nesting/ rearing grounds are lost, as these are typically when species are most vulnerable. Habitat loss may be driven by land use change and developing land that was once habitat.

Careful natural resource management planning can reduce the negative impacts of human activities on species at risk and their habitat. Sustainable resource management planning attempts to meet the needs of present generations without compromising the ability of future generations to meet their own needs. These planning efforts are often focused on balancing objectives related to multiple values and interests, including species at risk conservation.

Habitat fragmentation is when a large area that a species has historically been known to utilize is broken into smaller areas of habitat. This can be especially problematic when these new smaller areas are very far away from each other and lack smaller pockets of suitable habitat in between that species can travel through. This is an issue that may be linked to habitat loss for some species such as birds who need interior forest habitat, or large mammals who need large areas of contiguous habitat to carry out their life cycles. Additionally, if members of a species cannot travel within their population to find mates who are genetically diverse from them, they are likely to mate with those who are genetically like them, increasing the likelihood for genetic mutations and disease.

Habitat fragmentation is a form of habitat loss; all forms of habitat loss can negatively impact the ability of a species to survive in an environment where they had previously been well established.

2.2 Pollution and Contaminants

Contamination of a habitat can be due to pollution that is present in the environment. Pollution of a habitat can make the habitat no longer suitable for the species or if the habitat continues to be used by members of the species it can dramatically decrease the chances of survival for individuals in the population. The presence of contaminants in prey species can also lead to **bioaccumulation** of contaminants in predator species, resulting in potential illness of individuals and the potential loss of food resources for a predator species.

There are two general types of environmental contaminants: those that are manufactured and introduced accidentally into the environment, and those that occur naturally but are artificially increased to harmful levels due to human activities. Many of these contaminants accumulate through the food chain and can be present in many commonly consumed food items, leading to buildup of these compounds in humans as well.

The introduction of pollutants can have negative impacts on ecosystems, especially vulnerable ones such as aquatic ecosystems. Nitrates are some of the most frequent aquatic pollutants, and are often traced back to runoff from fertilizer, wastewater treatment plants, animal waste, and septic systems into streams or ponds.

Nitrates coupled with phosphates can increase the rate of **eutrophication** in water can result in increased plant growth. This can lead to **algal blooms**, which negatively affect aquatic ecosystems by limiting sunlight under the surface of the water, increasing the presence of minerals, and decreasing the levels of dissolved oxygen in the water. Algal blooms can be associated with lower levels of productivity in aquatic ecosystems and poor quality of life for species living within them.

CASE STUDY: Wavy-rayed lampmussel (*Lampsilis fasciola*) – Threatened

The wavy-rayed lampmussel (*Lampsilis* fascicola) is a freshwater mollusk that is designated as a threatened species in Ontario. Their habitat range presently includes several river systems within Southwestern Ontario. In these rivers, they typically occupy shallow riffles with sandy substrates, areas in a river where the water flows quickly over the riverbed. This region of the province is associated with high road density.

One of the major threats facing wavy-rayed lampmussels (Figure 1) is pollution, especially that caused by salt applied to roads in the colder months. These salts can increase the baseline chloride concentration of waterways and bodies of water. Road salt can travel into these aquatic environments through runoff directly from streets into waterways or retained in groundwater and soils until the warmer months to eventually be released into the water.

Mussel larvae (also known as glochida) require a fish host to complete their development into adult mussels. These larvae emerge into the water column in the warmer months and are especially vulnerable to contaminants at this stage. Exposure to high chloride concentrations can negatively impact their development by hindering host attachment, which would prevent the glochida from developing any further and halt the addition of individuals to the mature population.

Other stressors that limit the distribution and persistence of wavy-rayed lampmussels include **siltation**, pollution from agricultural runoff, invasive zebra mussels (*Dreissena polymorpha*), and habitat degradation.

Figure 1. Photo of wavy-rayed lampmussels (*Lampsilis fasciola*) listed as threatened in Ontario, Canada (Government of Ontario, 2016)

2.3 Invasive Species

Invasive species are non-native species that have been established in parts of the world outside of their natural range and cause harm to the local ecosystem. Invasive species can be a particular threat to local species because they lack natural predators to control population growth, while competing for the same resources or while destroying the native habitat as outlined in Figure 2.

Figure 2. Examples demonstrating how invasion drives species decline and habitat degradation (Invasive Species Centre, 2020).

Invasive species can successfully establish themselves in new ecosystems because of several characteristics, including:

- Tolerating a wide range of environmental conditions
- Widespread and rapid dispersal
- A diet that accommodates a variety of food sources
- A lack of predators in the settled environment

Many invasive species are introduced and spread through human activity, whether accidentally or intentionally. Aquatic invasive species can be carried by vectors such as the hull of vessels and ballast water, or purposefully introduced for recreational purposes. Terrestrial invasive species can be spread through intentional introduction, the global trade of lumber or food products, shipping crates, or escape from captivity.

For example, the emerald ash borer (EAB, Agrilus planipennis), is a beetle that naturally occurs in Asia and was first detected in North America in 2002 after arriving in wooden shipping materials. This beetle poses a serious threat to all ash trees (*Fraxinus* sp.) in North America, leading to their classification as species at risk on a global scale. Currently, EAB is managed through pesticidal treatments of surviving ash trees, artificial selection of resistant ash strains, introduction of natural predators (biological controls), and removal of infected individuals (Herms & McCullough, 2014).

Table 2: Some examples of invasive species with their place of origin, vector of introduction, and the impact they have had after introduction into a new ecosystem (NISIC, n.d.).

COMMON NAME	SCIENTIFIC NAME	VECTOR	IMPACT
Round goby	*Neogobius melanostomus*	Ballast water	Competes with and preys on native species
Zebra mussel	*Dreissena polymorpha*	Ballast water	Competes with native species, clogs pipes
Emerald ash borer	*Agrilus planipennis*	Imported cargo	Ash trees lose most of their canopy within 2 years of introduction and die within 3-4 years
European Common Reed	*Phragmites australis*	Ballast water (seed transportation)	Crowd out native species
Common/ European buckthorn	*Rhamnus cathartica*	Ornamental	Dominate ecosystems and displace native species

For more information about invasive species, please refer to the 2016 Ontario Envirothon Current Issue Guide here.

CASE STUDY: Little Brown myotis (*Myo is lucifugus*) - Endangered

The little brown myotis, formerly known as little brown bat (Figure 3), is an endangered bat species. Its range includes northern and central Ontario. It is at-risk due to white nose syndrome, an introduced fungus *Pseudogymnoascus destructans* (*Pd*). This fungus is passed from bat to bat in hibernation sites, of which many species of bat will hibernate together and spread the fungus to one another. Many species are vulnerable to it, including little brown myotis, northern long-eared bat, and tricoloured bat. White nose syndrome has negatively impacted many bat populations across North America and has led to the classification of multiple species at risk.

Torpor, or a period of inactivity, is a normal occurrence for many bats, including the little brown myotis. This is similar to hibernation, as it occurs over the colder months of the year. Some periods of activity during torpor are normal, but when there are significant increases in activity during torpor, bats can expend too much energy and die before the end of the wintering period.

White nose syndrome contributes to an increased frequency of torpor activity and exhausts the bats as they overwinter. This can lead to death, as they expend energy that they do not have to spare in the winter months. (Elhman *et al.*, 2013).

Figure 3. Photo of little brown myotis (*Myotis lucifugus*) listed as Endangered in Ontario, Canada (von Linden, 2008).

2.4 Climate Change

Climate change is the term used to describe rapid and extreme changes in global weather patterns. With regards to species at risk, this is an issue that limits many species' ability to adapt to their environment and interacts with threats such as habitat loss to further exacerbate the decline of a species (IUCN, 2021). Rising temperatures have led to ecological, physiological, and behavioural changes in species. This includes changes to migration patterns and a change in breeding times for some animals.

The timing of life cycle events is one example of how bird species in particular are currently affected by climate change. Ontario is home to many migratory bird species that are reliant on high insect populations in the early summer to feed their young. With a warming climate however, insects are emerging and breeding earlier in the year than they would have in the past, thus causing a mismatch in timing between the young birds' demand for food and the period of high insect populations. This ultimately impacts bird population numbers as a whole and the amount of healthy offspring the affected bird species can produce (Birds Canada, nd).

Trees and other plants, species that cannot move on their own, are also at risk due to rapid changes in their environments. Changes in precipitation and water availability, climate or microclimate, growing season, and increased presence of pests can impact the range at which any given plant can live at a rate faster than what they can accommodate (Johnston et al, 2009). This effect is more obvious on the more southern edges of a plant's range.

Climate change can also allow for the introduction of invasive species or the proliferation of an already present non-native species by providing more favourable conditions (Invasive Species Centre, nd). See prior section on the impact of invasive species on species at risk.

3.0 Management/ Recovery Strategies

Recovery strategies are prepared by a panel of experts in scientific research, government, industry, and environmental non-profit organizations. These strategy documents review recent data on Threatened and Endangered species, as well as their habitat, to determine the subsequent action necessary to recover populations. Recovery strategies are followed by action plans, which outline the necessary projects to reach recovery targets.

3.1 Monitoring

Monitoring can occur through a variety of methods, including active surveillance through a designated area either on foot or via vehicle, such as helicopter surveys for larger mammals such as moose or caribou. Less intrusive methods of monitoring could include roadside surveys for roadkill or animal sign, the capture of organisms and implementation of GPS trackers, and distributing camera traps within a certain range. Monitoring programs that are more environment-focused typically involve surveys with a focus on the analysis of ecosystem components, such as soil and water quality, growth rates, and chemical analysis to determine the presence of contaminants. Much of analysis and interpretation of the results occur in lab, save for certain notable qualitative field observations that may provide an indication of potential impact sources such as contaminants, disruptive activities, and/or competing organisms.

3.2 Habitat Restoration

For species at risk, habitat quality or availability can play an important part in population persistence. Some species may have specific criteria for suitable habitat to meet life requirements, such as **hibernacula**, wintering areas, or breeding sites. When these sites become degraded or destroyed, populations may be impacted to the point of listing as a species at risk.

The objective of **restoration** efforts is to gradually recover habitats, including species compositions and patterns, in areas that have been impacted by disturbance and work to restore their original ecological function(s) (Figure 4). This approach to species management can initiate or accelerate the course of the **species population** recovery. Restoration projects may come in the form of invasive species removal, forest regeneration, installing risk mitigation structures, or cleaning up garbage. In one example of aquatic environments specifically, stream habitats can be maintained by planting vegetation along the streambank to stabilize the channel edges from erosion, reduce excess nutrient and/or contaminant loads, and provide shade, such as in tall grass prairies.

Figure 4. The Annie Crescent Stream Bank Restoration Project, led by the Toronto and Region Conservation Authority in Ajax, Ontario, between April 2014 (top right) and June 2017 (bottom left) (TRCA, n.d.).

Photo: G. A Morris

4.0 Role of Organizations

4.1 Endangered Species Act of Ontario

The Endangered Species Act (ESA) is legislation first established in 2007 that provides science-based assessment of species, automatic legal protection to species classified as endangered or threatened, and habitat protection to those very same species. Additionally, the ESA sets out tools to help reduce the impact of human activity on species and their habitat and tools to encourage protection and recovery activities.

When a species is listed as endangered or threatened, their general habitat is automatically protected. This includes dens, nests, anad hibernacula, or other residences; places where a species needs to carry out their life.

Upon identification as a species at risk, recovery strategies must be completed within one year for endangered species and two years for threatened species. For special concern species, management plans must be completed within five years, unless they require a recovery strategy or management plan under the federal Species at Risk Act. These plans and strategies replace the automatic habitat protections once they have been developed (Government of Ontario, 2014).

Species protection from human activity

Section 9 of the ESA states that "No person will kill, harm, harass, capture, or take a living member of a species that is listed on the Species at Risk in Ontario list as an extirpated, endangered, or threatened species in Ontario." It further clarifies that a species is protected at every stage of its development.

Any proposed activity that may potentially kill, harm, or harass a protected species at risk must first go past the MNRF as a notice of activity. From there, it is up to the ministry to determine whether the activity would be harmful. These are often complex scenarios, as measuring the impacts of an activity on a single species requires an understand of their specific biology and behaviour, how they interact with their habitat, and what key features they require to thrive (Government of Ontario, 2019).

When assessing whether an activity is likely to kill, harm, or harass a member of a protected species, there are some key biological factors that must be reviewed:

Table 3: Key biological features to look for when assessing impact of activities on species at risk. (Government of Ontario, 2019)

BIOLOGICAL FACTOR:	EXPLANATION:
Site fidelity	Repeated use of an area, such as a hibernacula/overwintering sites, make them more important to species and thus more sensitive to change.
Concentration of individuals	The more individuals in a group of species (such as a colony), the greater chance of one member being impacted by any activities.
Mobility	A species with limited mobility will be more greatly impacted (e.g. plants, hibernating animals), whereas species with higher mobility (e.g. travels in search of food, migratory) will be less impacted by activities.
Ecological sensitiveness	Some species have biological characteristics or tendencies that make them particularly vulnerable (e.g. amphibians are highly sensitive to chemical contaminants, shade-tolerant plants cannot tolerate high levels of light)
Current condition	Members of a species that are already in a stressed condition or showing signs of poor health are generally less likely to be able to tolerate additional disturbance.
Life stage	Generally, juvenile members of a species are more sensitive than adults and are more likely to face harm from activities.
Response to disturbance	When an activity disturbs a member of a species that demonstrates less tolerance to disturbances (e.g. birds that abandon their nest), there is a greater likelihood that the activity will cause harm.

While biological features are important, one must also consider how specific actions will impact protected species. Things to consider include:

- Proximity to species
- Timing (ie. migration, hibernation, spawning)
- Intensity of activity
- Duration and persistence of effects
- Frequency
- Permanency

4.2 COSEWIC

The Species at Risk Act allowed for the formalized recognition and funding of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent advisory committee that meets one to two times per year to assess the status of Canadian species and provide recommendations on species at risk status and management to the Ministry of the Environment and Climate Change Canada.

People who participate in the COSEWIC committee can include:

- Wildlife and biological scientists
- Indigenous knowledge holders
- Managers or people with significant management experience in:
    - Fisheries
    - Wildlife Management
    - Ecology
    - Genetics
    - Systematics
    - Risk Assessment

The majority of COSEWIC members have years of experience in their field of expertise before serving on the committee. There is also a subcommittee of COSEWIC called the Aboriginal Traditional Knowledge (ATK) subcommittee made of individuals chosen by the Minister of ECCC from individuals nominated by National Aboriginal Organizations.

COSEWIC only assesses Canadian species that it believes could be at risk, meaning it is difficult for under researched species to be evaluated by the current conservation status frameworks. Often, more information must be collected before COSEWIC can proceed with status designation (COSEWIC, 2021).

COSEWIC considers many different species in a variety of taxonomic groups for status designation: amphibians, reptiles, arthropods, birds, freshwater fishes, marine fishes, marine mammals, mollusks, mosses, lichens, terrestrial mammals, and vascular plants. Organisms outside of these groups can be considered for conservation status if a report prepared by a third party is shared with the committee (COSEWIC, 2021).

For the safety of discussed species-at-risk populations, COSEWIC meetings are not directly open to the public, but the Chair of the meeting may permit some observers to attend meetings if they possess important knowledge about the species under assessment.

4.3 COSSARO

The Committee on the Status of Species at Risk in Ontario (COSSARO) aims to assess every species indicated to be decreasing in population size in Ontario. COSSARO uses existing data and available research to determine species eligibility for assessment. COSSARO must assess every species evaluated by its national counterpart COSEWIC to reflect how populations in Ontario are doing compared to the entire Canadian species population but may assess species that COSEWIC has not evaluated before. COSSARO meetings typically occur annually and are open to interested stakeholders and members of the public who are willing to complete observer application forms (COSSARO, n.d.).

COSSARO uses the following criteria to inform status designation of different species-at-risk focusing on species populations in Ontario:

- Has there has been a decline in the number of mature individuals of the species in Ontario?
- Has there been a decline or fluctuation of the species distribution range in Ontario?
- How big is the Ontario population of the species?
- What do the projected population trends say about the Ontario population of the species?

Where available, data analysis and population trends that have been projected for a species can act as valuable tools for population health assessment because they can give an indication of how the population will perform over time. They can also potentially be used to identify areas where individuals of that population are most vulnerable. Changes in population trends can be strong indicators of what the future of a species population will look like and if there are acute projected problems that the species will benefit from conservation management action to improve the projected survival rates of the species.

COSSARO provides many insights that can be used to create more effective conservation management action plans specifically tailored to Ontario, providing an assessment of currently available information and research about species living at least a portion of their lifecycle in Ontario. This is useful to provide a better understanding of national species populations and specific populations in Ontario. With more specific information provided about a population, there is a higher likelihood that effective recovery strategies can be created and implemented for species conservation.

5.0 Role of Collaborators

5.1 Parks and Protected Areas

Parks and conservation areas help to identify and categorize areas where species diversity is high or where species might be vulnerable to changes in the environment. This helps identify areas where limiting human traffic and enforcing environmental protection plans would be beneficial for species living in the area. parks and conservation areas may be established in places considered to be hotspots for species diversity and that represent unique or rare habitat (The Ministry of the Environment, Conservation and Parks, 2022). The formalization of protected areas through parks and conservation areas allows conservation managers to prioritize conservation goals. The level of protection and access provided to the public influences the human impact on the species present in the managed areas.

Figure 5. An Eastern Foxsnake (*Pantherophis gloydi*), a species that is commonly monitored in provincial parks in central and southern Ontario. The Carolinian population of these species is endangered, and the Georgian Bay population is threatened.

5.2 Indigenous Communities and Organizations

Indigenous communities and organizations are important in species-at-risk conservation, as they can provide Indigenous knowledge surrounding species-at-risk. When there are species at risk who are understudied, cryptic, or data deficient, Local Ecological Knowledge (LEK) and Indigenous knowledge can provide insight about species migration, habitat, lifecycle, and other key insights of species patterns and behaviours. The best way to incorporate Indigenous knowledge is by providing and prioritizing spaces in the scientific community where Indigenous voices are incorporated, listened to, and delivered by Indigenous people working or involved in conservation efforts and management. Moving forward, conservation management should continue to provide a space where Indigenous people are supported in the scientific community to share and apply their knowledge, both becoming and continuing to be leaders in stewardship and conservation action.

5.3 Accredited Zoos and Aquariums

Organizations that provide wildlife education and promote human connection to other species are extremely valuable in garnering support for different conservation efforts and spread awareness of issues affecting species in the wild causing them to become at risk. Public support can aide in raising funds for research and conservation efforts and inspire more people to go into conservation work.

In Canada, there is an **accreditation** program for zoos and aquariums through an organization called Canada's Accredited Zoos and Aquariums (CAZA), which was founded in 1975 with the aim of advancing zoos and aquariums as leaders in animal welfare, wildlife conservation, science, and wildlife education (CAZA, 2016). CAZA evaluates accredited facilities based on operational facility standards and ethical standards set out by CAZA to prioritize animal welfare by zoos and aquariums. CAZA does not hold the power to suspend operation permits, so members of the organization who are found in violation of regulations set out by CAZA are encouraged to change their policies and procedures to meet regulations. If they fail to do so, they are stripped of their CAZA accreditation and membership.

Some of the CAZA accredited facilities in Ontario include:

- Cochrane Polar Bear Habitat
- Little Ray's Reptile Zoo (Ottawa & Hamilton locations)
- Ripley's Aquarium
- Science North
- Toronto Zoo

Many of the above listed facilities, like Ripley's Aquarium, provide large donations to conservation organizations like the Ontario Turtle Conservation Center, who are working towards conservation efforts of species at risk. Funding is an important tool necessary for meaningful and consistent conservation action (RAC, 2022).

Rehabilitation programs are an important aspect of accredited zoos that help species-at-risk conservation efforts. In Ontario, the Toronto Zoo runs several species recovery, breeding, and reintroduction programs for species at risk to aid in increasing wild population numbers. Organizations like the Toronto Zoo engage a wide audience of people to become passionate about species recovery funding and large-scale recovery projects, like the Adopt-A-Pond wetland recovery program, which aims to inspire citizens to take stewardship action and conserve their local wetlands (Toronto Zoo, n.d.).

6.0 Conclusion

Careful management of species populations and habitat can reduce the risk of species becoming listed as a species at risk. Many species have already been identified as at-risk, and some require more information to be collected to properly assess the species' status. Species at risk is an important area of research in environmental conservation and there are many vulnerable populations that require more study to be properly supported by conservation efforts. Conservation and recovery strategies may be most effective when supported by research created by interdisciplinary teams incorporating multiple values and objectives, and following an adaptive process.

The biology, threats, management actions, and public awareness of species at risk continues to be an important area of study and practice for environmental professionals.

7.0 Glossary

A

Accreditation: An official certification offered by school or organization that upholds standards set by external reputable parties.

Algal bloom: Rapid growth of algae or cyanobacteria in water bodies – typically to the detriment of aquatic ecosystems.

Anthropogenic: Effects occurring because of human activity, usually in reference to environmental pollutants.

B

Bioaccumulation: An increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment.

C

Climate change: A change in the average conditions such as temperature and rainfall. These shifts may be natural, but human activity has been the primary driver of climate change since the 1800's due to the burning of fossil fuels (which produces heat-trapping gases that increase the global temperature) and other activities that impact the state of the Earth's atmosphere.

Conservation: Preservation and protection efforts, specifically that of environmental and biological factors.

Conservation status: An indicator of the level presence of a group of organisms displays within a certain spatial scale.

E

Eutrophication: Excessive nutrient levels present within a water body that result in increased plant growth and a lack of oxygen.

Extinction: The dying out or extermination of a species; having no living members.

Extirpation: Extinction of a species within a localized area affecting a population.

F

Fluctuation: An irregular rising and falling of a certain number or amount.

H

Habitat: The natural environment of an organism.

Hibernacula: A refuge, typically underground-in which an organism uses to overwinter

M

Mitigation: The act of reducing the severity or seriousness of something.

N

Native species: A species that would naturally be found in an area that would be there without the help or introduction to the area through human activity.

R

Restoration: The process of returning an area to an original or improved condition. For more information on ecosystem restoration see 2022 Current Issue Guide on Ecosystem Restoration.

S

Siltation: The suspension of fine clay and silt particles in the water or the buildup of these fine sediments on the river bottom. Also known as sediment pollution.

Species population: A group of individuals existing within the same geographic range that interbreed with one another.

Subspecies: A group or population who are a geographically isolated portion of the species and are genetically dissimilar to other members of the species but can still have viable offspring with other species members when ranges do overlap.

8.0 References

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