

INTRODUCTION

Understanding the life history of a species is important as it is usually the first area to look at when you are trying to understand why a species might be in trouble. A species' life history has evolved through natural selection and is a finely balanced tradeoff of their available resources between the growth, reproduction and survival of a species. The kind of tradeoffs are aspects such as the start of first breeding, how often they have offspring and the amount of offspring that they have each time they breed. A species may for instance have many offspring but with little parental care or only have one offspring, but with close individual care e.g. Insects compared to Humans. These tradeoffs in resource allocation over an individual's life has evolved such that each species is maximizing or is close to maximizing the amount of offspring that will survive and breed successfully in the next generation. Naturally, over millions of years, the life history adjusts to changes in a species environment, but in the day and age of humanity, they are usually not afforded the opportunity to make the necessary adjustments.

Southern African vultures are long lived species that live for twenty to forty years. They are slow to reach sexual maturity taking anything from six to nine years. Most species pair for life. They produce one and at most two eggs every one or two years. The eggs take a relatively long time to incubate of between forty-five and sixty days. Both parents are needed to look after the egg and to provide food and protect the chick until it fledges at three to five months. The fledgling is then still dependent on the parents for food for up to another 6 months.

Many of the traits in the life history strategy of vultures do not work in their favour as a group and increase their vulnerability to natural and human threats.

AIM AND PURPOSE OF LESSON

The aim of this lesson plan is to introduce students to the concepts of life history and life history strategy. The purpose is that they will learn that there is a variety of life history strategies that has evolved to maximize a specific species chance of having successful reproductive offspring. A species specific life history strategy may increase or lessen their vulnerability to natural or human threats.

DURATION OF LESSON

60 minutes

TARGET AGE OF LESSON PLAN

Ages 11 to 15 or Grade 5 to 9

MATERIALS NEEDED

The teacher will need:

1. Lesson Plan 4 – Life history of Vultures
2. A computer with internet connection to view the suggested video.
3. Video: The Mayfly – a life history by Fish On Productions (4:19 min)
<https://www.youtube.com/watch?v=PBHBFck67D8>
4. OPTIONAL – projector and sound system to watch the video.
5. Answer Sheets 1, 2 and 3 in Appendix A

The Students will need:

1. Fact sheet 1 - Lappet-faced Vultures (downloadable from BirdLife South Africa's website <http://www.birdlife.org.za/documents/bird-of-the-year>)
2. Fact sheet 3 - Threats to Vultures (downloadable from BirdLife South Africa's website <http://www.birdlife.org.za/documents/bird-of-the-year>)
3. Questionnaires 1 – 3 in Appendix B (downloadable from BirdLife South Africa's website <http://www.birdlife.org.za/documents/bird-of-the-year>)
4. Pen and paper
5. OPTIONAL: Family photos and prestik – From sonar photos to photos of grandparents. A student can also aim to have photos of an older individual family member (e.g. a grandparent) throughout his or her life.

OBJECTIVES AND OUTPUTS

The student will:

- Discuss what they understand about life history and life history strategy.
- Watch the video on Mayfly life history.
- Demonstrate human life history.
- Read up on Lappet-faced Vulture life history.
- Compare and understand the difference in life history and life history strategy of the different species studied and trade-offs involved in each strategy.
- Discuss in groups what they have learned about the life history and life history of each species studied, how they differ from each other and the trade-offs involved in each strategy.
- Read up on threats to vultures and how their life history and life history strategy contribute to their decline.
- Discuss in groups what they have learned about threats to vultures and how their life history and life history strategy contribute to their decline.
- Report back to the teacher in their allocated groups.
- Have a better understanding of the concepts of life history and life history strategy and how different strategies have evolved with different trade-offs.
- Have a better understanding of how a species life history and life history strategy can contribute to its decline in the light of threats faced and also how it can be used to better decide how it can be conserved.

VOCABULARY

Evolve: to change or develop gradually in response to the environment.

Life history: (or lifecycle) is the traits of growth, survival and reproduction events typical for a member of a species.

Life history strategy: is the collection of life history traits (numbers of offspring, timing of reproduction, amount of parental care etc.) that allow a species to best use its available resources to maximize offspring survival and reproduction in the environment it occur.

Natural selection: the process whereby organisms better adapted to their environment tend to survive and produce more offspring.

Resources: the energy and nutrients that all living organisms need to grow, maintain their bodies and reproduce.

Stage: a step in a process.

Trade-off: a balance achieved between two desirable but incompatible features.

Trait: a genetically determined characteristic.

PROCEDURE

- [Duration 5 min] Begin the lesson with an entry task where students must think and discuss what they understand with life history and life history strategy. Ask the following questions to the whole class and give them a few opportunities to raise their hands and answer the questions:
 - What do they understand about the terms life history (or life cycle)?
 - Have they noticed that some species live for a long time and others only for a short time? Can they name some examples e.g. their pets?
 - Have they noticed that some species have many offspring and some only a few? Can they name some examples e.g. their pets?
 - Can they think of reasons of why different strategies (or approaches) have evolved for different species as to how long they live and as to how many offspring they have?
- [Duration 5 min] Set up the projector / TV / Computer and watch the video: The Mayfly – a life history by Fish On Productions (4:19 min). Ask them to focus on the following questions:
 - Can they identify the different life history stages of the Mayfly?
 - Are any of the stages more important than any of the other?
 - Do Mayflies live for a long time or a short time?
 - Do they have many offspring or only a few?
 - Try to remember the details of what you are seeing, reading and hearing.
- [Duration 5 min] Divide the students into three small discussion groups and allow them 5 minutes to discuss what they have learned and remembered from the video. Let them write down what they remembered and discussed.
- [Duration 5 min] Individually ask the students to demonstrate the life history stages of humans. They can do it by drawing the different stages or optionally by placing photos of their family members or of an older individual family member (e.g. a grandparent) throughout his or her life. Ask them to think about the following questions while they work on the demonstration:
 - How many life history stages do humans have?
 - Do humans live for a long time or a short time?

- c. Do they have many offspring or only a few?
 - d. How does the life history stages of humans compared to Mayflies?
 - e. Does the life history strategy of humans differ from Mayflies?
5. [Duration 5 min] Divide the students into three small discussion groups and allow them 5 minutes to discuss and compare what they have learned and thought about as they developed their human life history demonstration. Let them write down what they remembered and discussed.
 6. [Duration 10 min] Ask the students to read Fact Sheet 1 - Lappet-faced Vulture and the Fact Sheet 3 - Threats to Vultures. Ask them to focus on the following questions while they work through the fact sheets:
 - a. How many life history stages do Lappet-faced Vultures have?
 - b. Do Lappet-faced vultures live for a long time or a short time?
 - c. Do they have many offspring or only a few?
 - d. How does the life history stages of Lappet-faced Vultures compare to humans and Mayflies?
 - e. Does the life history strategy of Lappet-faced Vultures differ from Mayflies and Humans?
 - f. Does the life history strategy of Lappet-faced Vultures contribute to their decline?
 - g. Are Lappet-faced vultures more in danger of threats at certain stages of their life history?
 7. [Duration 5 min] Divide the students into the same small discussion groups and allow them 5 minutes to discuss what they have learned from reading the two fact sheets. Let them write down what they remembered and discussed.
 8. [Duration 15 min] Students will now have 5 minutes to report back in their groups to the class and the teacher. They can use the notes they made during group discussions to help them remember what they have learned. To make this less time consuming, assign only one of the activities (Mayfly video, Human demonstration or Lappet-faced Vulture fact sheets) to each group to report back on. Use Answer Sheets 1, 2 and 3 to guide the discussion and evaluate their answers.
 - a. OPTIONAL: Use Answer Sheets 1, 2 and 3 instead to ask the students specific questions based on the videos. Or hand out Questionnaires 1, 2, 3 and give them 10 minutes to answer the questions.
 9. [Duration 5 min] Lastly, allow the students to go back to their seats and end the lesson with a few questions to the whole class to help them think about the future:
 - a. Do they think knowledge on a species life history and life history strategy can help conservationist decide what best they can do to help conserve a species?
 - b. Thinking of the threats to vultures and where Lappet-faced Vultures are in danger based on their life history and life history strategy can you think of how they can maybe be better conserved?
 - c. What do they think they can do to help the vultures?

APPENDIX A

ANSWER SHEET 1: THE MAYFLY – A LIFE HISTORY BY FISH ON PRODUCTIONS

1. Why are they called Mayflies?
Until a discrepancy of 11 days when the calendar changed from the Julian to Gregorian calendar, Mayflies almost exclusively emerged in the month of May. Now emergence span over the months of May and June.
2. Why is it a misconception that Mayflies only live for a couple of days?
It is true for the adult stage, but if you add the other life history stages they live for about two years.
3. Name the different life history stages, where they are found and the duration of each stage for the Mayflies species in the video.
 1. Egg stage – on the river bed - not indicated.
 2. Nymph stage – on the river bed – two years.
 3. Dun stage – surface of river and then bankside vegetation – couple of hours.
 4. Spinner stage (adult) – air and females on water to lay eggs – couple of days.
4. What is the purpose of each stage and what interesting did you notice about each stage?
 1. Egg stage – to keep the nymph safe until hatching – laid on the surface.
 2. Nymph stage – to eat organic detritus so that they can grow bigger – shed their skin up to 20 times as they grow.
 3. Dun stage – to escape from the water – no mouth parts to feed or sex organs to reproduce.
 4. Spinner stage – to reproduce – no mouth parts to feed.
5. Why do you think it is necessary that these Mayflies have adopted a life history strategy of laying many eggs?
If they laid a limited amount of eggs, only a very few adults would probably have made it to adulthood especially as there is no adult care at any stage. In the video it can be seen that many of the Duns and Spinners are eaten by fish and we can assume that many other predators target all the stages. Events such as a flood can also lead to many eggs or nymphs being destroyed.
6. Why do the river keepers catch the Mayflies and what may the reason be for them doing so?
They catch them to protect the eggs so that they can give them a better chance of hatching and potentially a much higher survival rate. We can assume that human activities such as damming the river, channelling the bankside and water extraction has led to suitable habitat.

ANSWER SHEET 2: HUMAN LIFE HISTORY STAGES AND STRATEGY

1. Name the different life history stages and the duration of each stage for Humans.
 1. Foetus – 9 months.
 2. Baby – 2 years.
 3. Toddler – 3 years.
 4. Child – 10 years.
 5. Reproductive adult – 30 - 40 years.
 6. Post-productive adult (after menopause for women) – 30 - 40 years.
2. What is the purpose of each stage and what stands out for you about each stage?
 1. Foetus - to keep the foetus safe until birth – protected in the mother.
 2. Baby – to grow quickly – directly dependent on the mother for food and both parents for protection.
 3. Toddler – to grow quickly and to learn about the world – still dependent on the parents for food and protection.
 4. Child – to grow to adulthood and to learn about the world and how to survive on his / her own – still dependent on the parents for food and protection.
 5. Reproductive adult – to live his / her life – responsible for his / her own sustenance and protection and for the children under his / her care and the only human stage where they can reproduce.
 6. Post-productive adult – to live his / her life – not able to reproduce.
3. How does the human life history strategy compare to the Mayfly's?

Mayflies have many offspring with no investment in the survival of the offspring by the adults. Only a few offspring survive to reproductive stage. Humans only have a few children but with a lot of investment in the care and survival of the offspring by the parents. Most survive to reproductive stage.
4. Will babies, toddlers and children be able to survive without adult care?

Unless they have protection from their parents or another adult, it is very unlikely that they will survive to adulthood especially during the baby and toddler stages. This would have been the case even more prior to human civilization.
5. Why do you think humans have evolved a life history strategy of having only a few children?

It takes many years from birth before a human is able to survive on its own and reproduce. Even after they are physically able to reproduce, they may not be in a position to successfully nurture and care for a baby. Once they have a baby, it requires a lot of resources (physical resources and parental care) to ensure that a baby survive into adulthood.
6. Why do you think humans have a further life history stage after adulthood that do not directly contribute to reproduction?

Even as an independent adult, it can be difficult to always be able to provide all the needs of your children. In many families grandparents play a very important role in supporting the parents to successfully provide all the needs of their grandchildren. If you look at it from a biological perspective, it makes sense that by investing in their children and grandchildren's lives that a grandparent is able to ensure that their genes have a better chance of surviving through further generations.

ANSWER SHEET 3: LAPPET-FACED VULTURE LIFE HISTORY

1. Name the different life history stages and the duration of each stage for Lappet-faced vultures.
1. Egg – 55 days. 2. Hatchling – 125 – 135 days. 3. Fledgling – 170 days. Sub-adult – 5 years. Adult – 30 years.
2. What is the purpose of each stage and what stands out for you about each stage?
Egg – to keep the embryo safe until hatching – incubated by the parents. 2. Hatchling – to grow quickly – completely reliant on the parents for feeding and protection. Fledgling – to learn about the world but still reliant on the parents for feeding and protection. Sub-adult – to learn about the world and how to fend for itself without further input from the parents. Adult – Reproductive stage where it fends for itself and a new chick every second year along with its life partner.
3. How does the life history strategy of Lappet-faced vultures compare to Mayflies and Humans?
Lappet-faced Vultures have much less offspring than Mayflies but more than humans. Where Mayfly adults do not invest at all in the survival of their offspring, Lappet-faced Vulture adults do invest in the care and survival of their offspring but only to a limited extent and for a short period compared to Humans. More of their offspring survive to reproductive stage than Mayflies, but not as many as with humans where most survive.
4. Why do you think Lappet-faced Vultures have evolved a life history strategy of only looking after one offspring every two years and then only for a year?
There is a big energy cost to an adult vulture while it is looking after its offspring. They will probably not be able to maintain the amount of care and investment if they had to do it for a longer period. They for example breed during the dry season when there are a better chance of a steady food supply with more angulates dying. During the wet months there are less food available and there might not be enough for the adult to sustain itself and a chick. After a chick is reared they probably need time to recover the energy they expended before they can successfully breed, produce an egg and look after a new chick.
5. In light of the threats that Lappet-face Vultures face, what is possible reasons for why the survival rate is so low during their first year of life?
Eggs are predated by humans for their use. Disturbance during breeding may lead to the adults abandoning their nest. Due to less food availability as a result of human activities and expansion, adults may not be able to provide enough food to their offspring to allow them to survive. Fledglings are not as aware of possible threats in their environment as adults and may move into new areas so they are more likely to fly into and encounter obstacles such as powerlines, wind turbines and dams.
6. How does the life history strategy of Lappet-faced Vultures contribute to their decline?
Because they have a low fledging survival rate, take a long time of five to six years before they start breeding, have a relatively long period of 1 to 2 years between chicks and mostly raise only one chick at a time, they cannot breed quick enough to replace themselves.

APPENDIX B

QUESTIONNAIRE 1: THE MAYFLY – A LIFE HISTORY BY FISH ON PRODUCTIONS

1. Why are they called Mayflies?
2. Why is it a misconception that Mayflies only live for a couple of days?
3. Name the different life history stages, where they are found and the duration of each stage for the Mayflies species in the video.
4. What is the purpose of each stage and what interesting did you notice about each stage?
5. Why do you think it is necessary that these Mayflies have adopted a life history strategy of laying many eggs?
6. Why do the river keepers catch the Mayflies and what may the reason be for them doing so?

QUESTIONNAIRE 2: HUMAN LIFE HISTORY STAGES AND STRATEGY

1. Name the different life history stages and the duration of each stage for Humans.
2. What is the purpose of each stage and what stands out for you about each stage?
3. How does the human life history strategy compare to the Mayfly's?
4. Will babies, toddlers and children be able to survive without adult care?
5. Why do you think humans have evolved a life history strategy of having only a few children?
6. Why do you think humans have a further life history stage after adulthood that do not directly contribute to reproduction?

QUESTIONNAIRE 3: LAPPET-FACED VULTURE LIFE HISTORY

7. Name the different life history stages and the duration of each stage for Lappet-faced Vultures.
8. What is the purpose of each stage and what stands out for you about each stage?
9. How does the life history strategy of Lappet-faced Vultures compare to Mayflies and Humans?
10. Why do you think Lappet-faced Vultures have evolved a life history strategy of only looking after one offspring every two years and then only for a year?
11. In light of the threats that Lappet-face Vultures face, what is possible reasons for why the survival rate is so low during their first year of life?
12. How does the life history strategy of Lappet-faced Vultures contribute to their decline?