Taxonomic classification and species data collection

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Sequence guide for Teachers

Identifying new species

Learning Objective

Students will consider why some species may be considered 'different' from other organisms despite a similar appearance. They will also consider how this information may be communicated to the scientific community and the broader public.

This introductory piece aims to build on existing knowledge of taxonomic hierarchies and species identification (previously achieved via dichotomous keys).

Task 1.

Motivate students towards the idea that numerous new and exciting species are being discovered every single day. There are a multitude of online videos and resources that can assist with this. Seamounts, for example, are hotspots of marine biodiversity and can provide a powerful example of ongoing scientific discovery.

Individually or as a class, students can read the online article and view the accompanying video, *New dolphin species discovered in Victoria in 2011* (Ritchie, 2011). Aboard voyage IN2018_C01, during routine observations we identified this species of dolphin known as *Tursiops australis* also known by its common name, the Burrunan dolphin. It is worth mentioning that Burrunan is a name of Australian indigenous origin, meaning, 'large fish of the porpoise kind'. This online video and audio piece discusses how this species was identified as being different from its close relative the common bottlenose dolphin, *Tursiops truncates*, through analysis of its skull morphology.

Class discussion point. What features (physical or behavioural) make this species of dolphin distinct from its close relative, the common bottlenose dolphin?

Follow this discussion with how this information about the finding of a new species was communicated around the world.

Use of authentic species abundance and distribution data as obtained aboard RV *Investigator*.

Learning Objectives

This learning activity aims to continue to consolidate students' abilities to identify and differentiate between different organisms using a taxonomical hierarchy and physical features.

It also aims to expose students to authentic scientific data through which they can analyse trends, make predictions and formulate authentic solutions.

As part of this activity, students will gain exposure to an authentic data set collected aboard RV *Investigator*. This data set resembles that of species abundance and distribution data collected across a number of transects on a voyage from Brisbane to Hobart (Fig. 1.).

Figure 1. Voyage map depicting sampling transects from which seabird spatial distribution and abundance data was collected (Woehler et al. 2018). Transects originate in Brisbane and project southward towards Hobart, spanning a period of seven days.

A relatively accurate summary of this data has been compiled in the table below. This table contains species abundance and distribution data for some of the most common seabird species encountered on this voyage (Table 1.).

Species	Number of individuals observed						
	Transect 1 (14.5.18)	**Transect 2 (15.5.18)**	**Transect 3 (16.5.18)**	**Transect 4 (17.5.18)**	**Transect 5 (18.5.18)**	**Transect 6 (19.5.18)**	**Transect 7 (20.5.18)**
Pachyptila turtur	4	49	34	25	118	2588	5608
Morus serrator	1	17	25	1	4	0	19
Pterodroma macroptera	16	8	9	9	1	1	3
Thalassarche cauta	0	0	0	1	18	28	5
Sterna bergii	10	4	4	1	0	0	6
Thalassarche chlororhynchos	0	6	4	5	1	1	1
Thalassarche melanophrys	0	1	5	2	4	1	1
Puffinus assimilis	3	0	3	2	0	0	0

Table 1. This table has been adapted from data of Woehler et al. (2018) and depicts the number of observed individuals for the eight most common species observed on voyage by transect.

Task 2

Provide students with the handout *Surveying Seabirds aboard* RV *Investigator* (Appendix 1.).

Instruct students to select one species of seabird from the list provided in Table 1 and to examine their seabird abundance and distribution along the Brisbane to Hobart voyage. This activity will require the teacher to be familiar with the voyage data and will likely require further differentiation and scaffolding.

Individually or in pairs, students will examine their data and explain how the number of observations changes for their species over the duration of the voyage. The use of a graph may be encouraged to visualise abundance and distribution data.

Students will then suggest possible reasons for any trends that have been identified. Access to computers for further research may prove beneficial with respect to this task. This is a relatively open task that encourages exploration of possible explanations based on some evidence. Solutions may resemble those that relate to latitudinal related temperature gradients, presence of islands for nesting, food sources, etc.

Students are then prompted to note that three species of the genus *Thalassarche* were identified and observed on this voyage. Following the previous discussion held regarding the diagnostic features of the Burrunan dolphin, discuss why these members of the albatross or mollymawk family (genus: *Thalassarche*) are considered separate species.

Allow students to discuss, with a partner, the diagnostic features that may separate these species. This task can also incorporate the creation of a dichotomous key that aims to separate a number of species observed.

Diagnostic notes for teachers.

Genus: Thalassarche

Thalassarche or 'mollymawks' are a type of albatross that belong to the *Diomedeidae* family and *Procellariiformes* order along with shearwaters, fulmars and petrels. These organisms share the identifying features that they have a nasal passage that attaches to their upper bill and they possess a salt gland that is situated above the nasal passage with this assisting in desalinating their bodies.

They are often described to possess gull-like plumage with dark backs, mantles and tails and lighter coloured heads, underwings and bellies. Their bills are typically orange or yellow in colour, or can be dark featuring bright yellow lines.

Thalassarche cauta (Common name: Shy Albatross)

Distinctive from its Albatross relatives, the Shy Albatross can be identified by its white head, relatively narrow black underwing margins and diagnostic black thumbprint underwing. Its bill is of grey-yellow colour with a prominent yellow culmen and yellow tip (Fig. 2.).

For greater insights, a blog entry by Educator on Board Coad (2018) surrounding observations of the Shy Albatross aboard RV Investigator can be found on the CSIRO research website: https://research.csiro.au/educator-on-board/the-not-so-shy-albatross/.

Figure 2. Shy Albatross, *Tharassarche cauta*. Photo by ©Eric Woehler, BirdLife Tasmania.

Thalassarche chlororhynchos (Common name: Yellow-nosed Albatross)

The yellow-nosed albatross averages 81cm in length and is relatively typical with respect to Thalassarche colouration with a blackish-grey saddle, tail and upper wing contrasting and a white belly. One of the yellow-nosed albatross's more diagnostic features is its black bill with a vibrant yellow culminicorn and a pink tip.

Figure 3. Yellow-nosed albatross, *Thalassarche chlororhynchos*. Photo credit to David Cook Wildlife Photography.

Thalassarche melanophrys (Black-browed Albatross)

The black-browed albatross has a dark saddle and upperwings that contrast with its white belly and head. It has a diagnostically dark eyebrow and a yellow-orange bill that possesses a reddish orange tip.

Figure 4. Black-browed albatross, *Thalassarche melanophrys*. Photo credit to JJ Harrison.

Collecting authentic species data in a local environment

Learning Objectives

Students will use their newfound skills in taxonomic identification and data analysis, to collect authentic data from a local environment.

Students will be able to analyse this data and make predictions as to why particular species inhabit areas as observed.

Assessment Task

Students will collect species abundance data and abiotic variable data from a local outdoor location and will analyse this data for common trends within or between species. This location may be a coastal/beach region, inland region, swamp/marshland, bushland, or may simply be within school confines*. In achieving afore mentioned objectives, students will also gain experience in classifying species based on diagnostic features.

*Note that risk assessments will need to be completed and will differ depending on the location chosen to sample and may also differ between educational institution.

Part 1.

Students will be tasked with forming small groups that will later venture outside in order to collect species data. Whilst two to three students per group can be ideal, this activity can easily be modified or completed utilising larger student groups, should this assist with supervision and teacher assistance whilst outdoors.

As the teacher, it is important to be familiar with species within your school's local habitat and surrounds. Develop a taxonomic key to differentiate between common species of plants, birds, mammals and/or arthropods, etc., depending on your chosen focus. It is not essential, nor feasible to include all possible organisms that may be sighted, however, by students making in situ observations, these organisms can be identified retrospectively, upon return to the classroom.

Discuss with students the potential means for conducting structured observations of the survey area, whether this be along transects, using quadrats, within a timeframe and surveying radius, etc. Students should also develop a structured means for recording their species abundance and distribution data (or provide such a means to the class). An example has been provided in Appendix 2. This can easily be modified, for example, should students be particularly technologically able, encourage them to take a photograph of their organisms or record GPS coordinates using a mobile phone, this can be useful later when entering data into the Atlas of Living Australia.

Part 2.

In the classroom, students can spend some time collating their collected data and identifying remaining species.

For this part of the task, it is important that students can log onto the Atlas of Living Australia (ALA) through their online portal located at: https://www.ala.org.au/. Teachers may wish to create a class account.

Students can log their species sightings onto the ALA database and compare with other logged sightings in the area. In doing so students can discover the appeal of contributing to real-world citizen science. The ALA professional team can also assist with taxonomic classifications of potentially hard to identify organisms.

Demonstrate to students some of the key features of the ALA, in particular the ability to overlay abiotic data with species sightings before providing students with the opportunity to explore this feature.

Part 3.

In their groups, students can create a PowerPoint presentation, poster, or other visual representation of a chosen species (that they have observed) for assessment.

This presentation should aim to explore:

- The scientific name of this organism using binomial nomenclature as well as the organism's classification within the taxonomic hierarchy.
- Characteristics that both define the organism as a member of its species, as well as characteristics that differentiate it from closely related species of the same order.
- Methods used for data collection in the field.
- Analysis of the interrelationships between the organism and its surroundings, i.e. interactions with species that may be found within close proximity as well as where your species is found with respect to abiotic data collected.
- Classification of this organism with respect to its position within its ecosystem and food web.
- The effect of [potential] human activity on the habitat sampled and how this may affect the chosen species as part of that ecosystem.

A basic rubric for assessment has been provided in Appendix 3.

References

Coad, T. (2018, June 5). The not so shy albatross [Blog post]. Retrieved October, 15, 2018, from https://research.csiro.au/educator-on-board/the-not-so-shy-albatross/.

Ritchie, K. (2011, September 15). New dolphin species discovered in Victoria. Retrieved October, 12, 2018, from https://www.abc.net.au/news/2011-09-15/new-dolphin-species-discovered/2899894.

Woehler et al. (2018) unpublished data.

Permission has been provided for this unpublished data to be used for the purpose of this educational resource by project leader, Dr Eric Woehler.

Credit for seabird photography on student handout

Australasian Gannet (*Morus serrator)*

Avenue. Australasian gannet in flight. Wikipedia, January, 26, 2011, retrieved from https://en.wikipedia.org/wiki/Australasian_gannet#/media/File:Australasian_Gannet_(Morus_serrator)_in_flight,_from_above.jpg.

Black-browed albatross (*Thalassarche melanophrys*)

Harrison, J. Black-browed Albatross (Thalassarche melanophrys) in flight, East of the Tasman Peninsula, Australia. Wikipedia, 18 August 2012, retrieved from https://en.wikipedia.org/wiki/Black-browed_albatross#/media/File:Thalassarche_melanophrys_in_flight_2_-_SE_Tasmania.jpg.

Fairy Prion (*Pachyptila turtur*)

Sabine. Fairy Prion *Pachyptila turtur* off Northland Coast, Hauraki Gulf, New Zealand. Wikipedia, 22 December 2010, retrieved from https://en.wikipedia.org/wiki/Fairy_prion#/media/File:Fairy_prion_flight.JPG.

Great-winged Petrel (*Pterodroma macroptera*)

Harrison, J. Great-winged Petrel (*Pterodroma macroptera*), East of the Tasman Peninsula, Tasmania, Australia. Wikipedia, 27 May 2012, retrieved from https://en.wikipedia.org/wiki/Great-winged_petrel#/media/File:Pterodroma_macroptera_in_flight_3_-_SE_Tasmania.jpg.

Little Shearwater (*Puffinus assimilis*)

Claudia, F. Little Shearwater, Fardela Chica (*Puffinus assimilis elegans*). Far South Expeditions, n.d., retrieved from https://farsouthexpeditions.smugmug.com/Wildlife-Fauna/Birds-of-Chile/Little-Shearwater.

Yellow-nosed albatross (*Thalassarche chlororhynchos*)

Cook, D. Yellow-nosed Albatross (*Thalassarche chlororhynchos*). Flickr, 24 July 2010, retrieved from https://www.flickr.com/photos/kookr/4836215711.

Photographs of the Shy albatross (*Thalassarche cauta*) and Crested Tern (*Sterna bergii*), taken on voyage by ©Eric Woehler, BirdLife Tasmania.

Appendix 1. Student task utilising data from Brisbane to Hobart voyage aboard RV Investigator, May 2018.

Surveying Seabirds aboard RV *Investigator*

In May 2018, a team of scientists embarked on a scientific voyage from Brisbane to Hobart. Along the way, they surveyed the many species of seabirds that they could identify. To do this they counted the number of each species of bird that crossed their path.

The scientists only searched for seabirds during the day (when they could see!). Each day, they started a new *transect*.

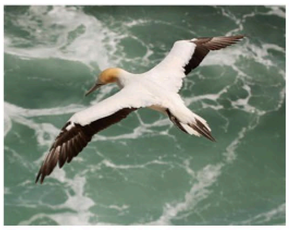
Have a look at the voyage map constructed by Woehler et al. (2018) and see if you can track where the scientists observed these seabirds.

The eight most common seabird species observed on this voyage were:

Fairy Prion
(*Pachyptila turtur*)

Little Shearwater
(*Puffinus assimilis*)

Great-winged Petrel
(*Pterodroma macroptera*)



Australasian Gannet
(*Morus serrator*)

Shy Albatross
(*Thalassarche cauta*)

Black-browed Albatross
(*Thalassarche melanophrys*)

Yellow-nosed Albatross
(*Thalassarche chlororhynchos*)

Crested Tern
(*Sterna bergii*)

*Photo credit acknowledged in References

The number of sightings of each of these bird species along each transect of the voyage is summarised in the table below (Woehler et al., 2018).

Species	Number of individuals observed on each transect						
	Transect 1 (14.5.18)	**Transect 2 (15.5.18)**	**Transect 3 (16.5.18)**	**Transect 4 (17.5.18)**	**Transect 5 (18.5.18)**	**Transect 6 (19.5.18)**	**Transect 7 (20.5.18)**
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Thalassarche melanophrys	0	1	5	2	4	1	1
Puffinus assimilis	3	0	3	2	0	0	0

1. Select one species of seabird from the list above and look at the data explaining its abundance and distribution.

a) How does the number of sightings of your species change over *Investigator's* voyage from Brisbane to Hobart?

b) Explain possible reasons for your answer above. You might need to research some information about your seabird first.
Think about, what is their habitat?
What temperatures and conditions do they prefer?
What do they eat? etc.

3. Three species of albatross were observed on this voyage. The shy albatross (*Thalassarche cauta*), the black-browed albatross (*Thalassarche melanophrys)* and the yellow-nosed albatross (*Thalassarche chlororhynchos*).

a) Explain what features of these organisms are common to the genus, *Thalassarche*.

b) Compare and explain what features are unique to the three different species, *cauta*, *melanophrys* and *chlororhynchos*.

4. Select **four** of the observed species and create a **dichotomous key** that can be used to separate and identify these species from one another.

Appendix 2. Recording sheet for abundance and distribution data

Date ______________________

Name _______________________ Group Members ____

What is the environment that you are sampling?

What is the weather/environmental conditions like?

Transect Number	*Species* *If you do not know the species' name, describe the organism or take a photograph to identify it later.*	Abundance (Tally)	Notes on location / abiotic surroundings

Appendix 3. Standard rubric for assessment task

	Levels Criteria (Assessable Elements)	A Excellent	B Good	C Satisfactory	D Partial	E Minimal
Science Understanding	Classify and organise diverse organisms based on observable differences (ACSSU111).	Comprehensively informed classification and organisation of diverse organisms based on observable differences and a taxonomic key. Classification utilises a hierarchical classification system in a highly accurate and effective manner.	Well-informed classification and organisation of diverse organisms based on observable differences and the use of a taxonomic key. Classification utilises a hierarchical classification system in a mostly accurate and effective manner.	Reasonably informed classification and organisation of diverse organisms based on observable differences and a taxonomic key. Classification utilises a hierarchical classification system in a generally accurate and effective manner.	Partially informed classification and organisation of diverse organisms based on observable differences and a taxonomic key. Classification utilises a hierarchical classification system in a partially accurate and effective manner.	Classification and organisation of diverse organisms based on observable differences and a taxonomic key with direction.
Science Inquiry Skills	Summarise data from different sources, describe trends and refer to the quality of their data when suggesting improvements to their methods (ACSIS130).	Highly logical and concise summary of data from different sources and a highly effective description of trends that are used to form highly logical and precise conclusions.	Mostly logical summary of data from different sources and a mostly effective description of trends that are used to form mostly logical conclusions.	Generally logical summary of data from different sources and reasonably effective description of trends that are used to form reasonably logical conclusions.	Partially logical summary of data from different sources and superficial description of trends that are used to form partially logical conclusions	Simple summary of data from different sources and minimal description of trends with an attempt to formulate a conclusion.
	Communicate their ideas, methods and findings using scientific language and appropriate representations (ACSIS133).	Highly effective communication of ideas, methods and findings using scientific language and highly appropriate representations.	Mostly effective communication of ideas, methods and findings using scientific language and mostly appropriate representations.	Generally effective communication of ideas, methods and findings using scientific language and generally appropriate representations.	Partially effective communication of ideas, methods and findings using scientific language and basic representations.	Rudimentary communication of ideas, methods and findings using scientific language and simple representations.