Asking and Answering Questions: ADW's Flexible Querying Tool

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Tricia Jones, George Hammond

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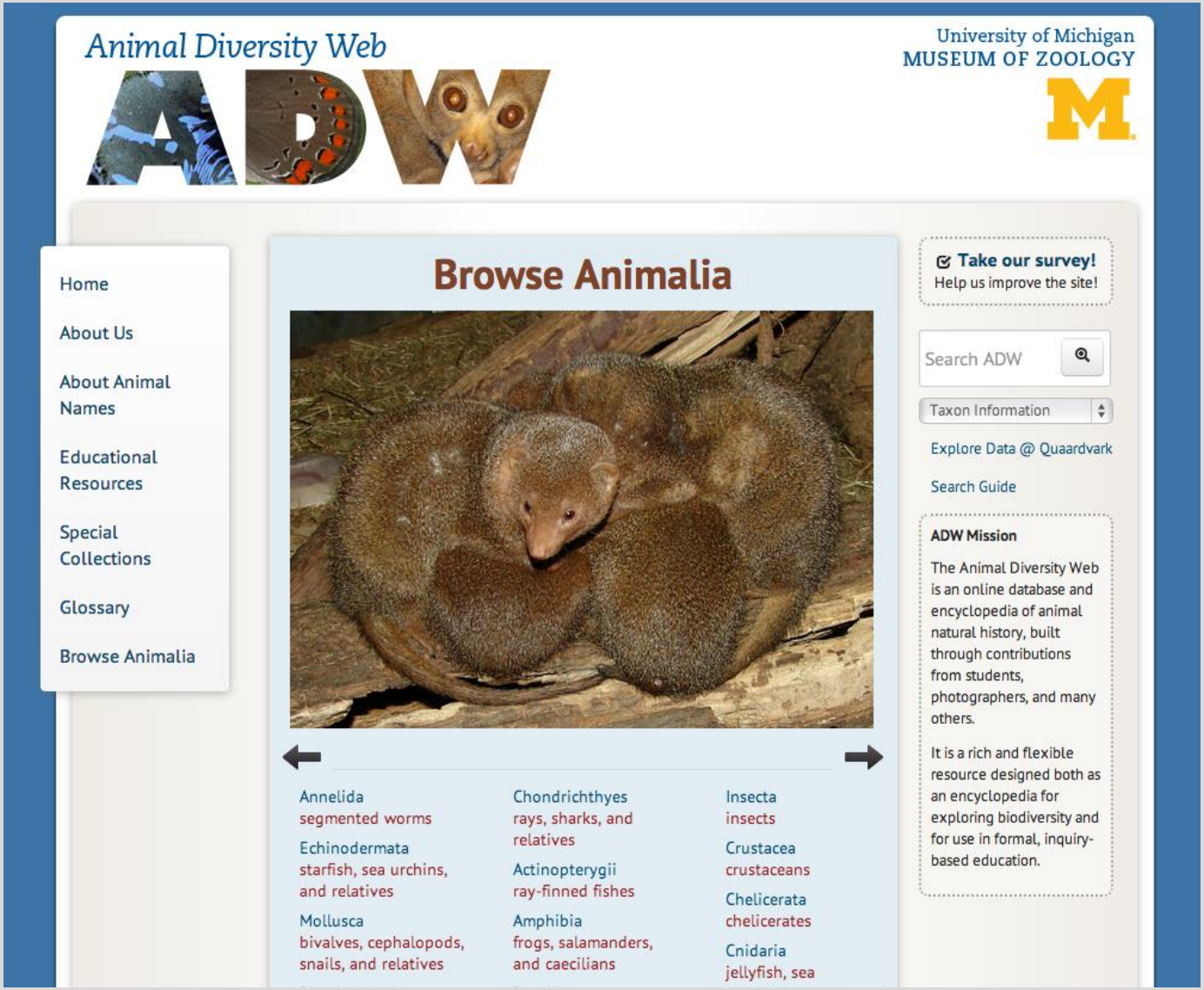

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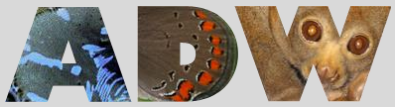


Understanding Science
how science *really* works

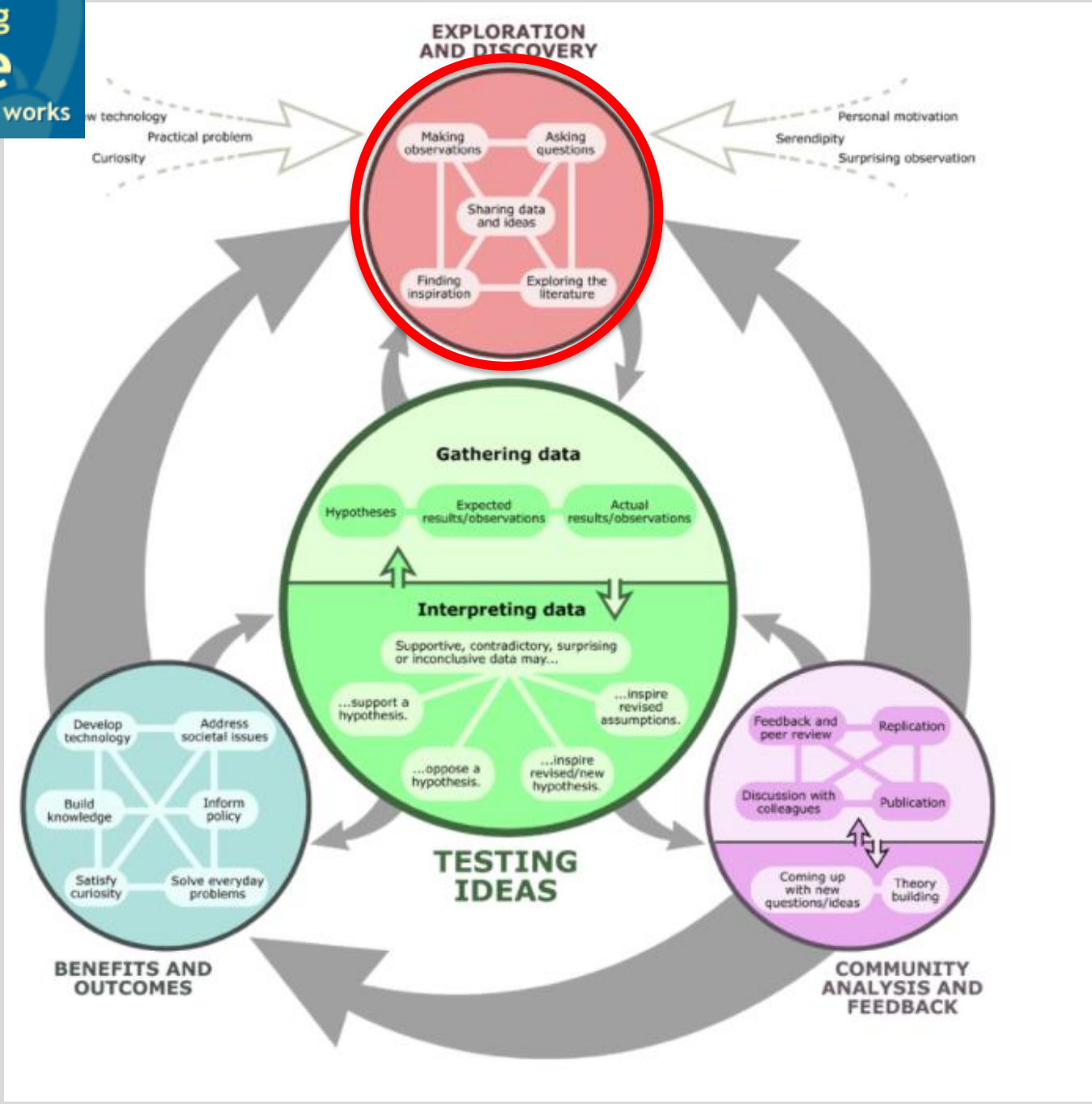
Explore!

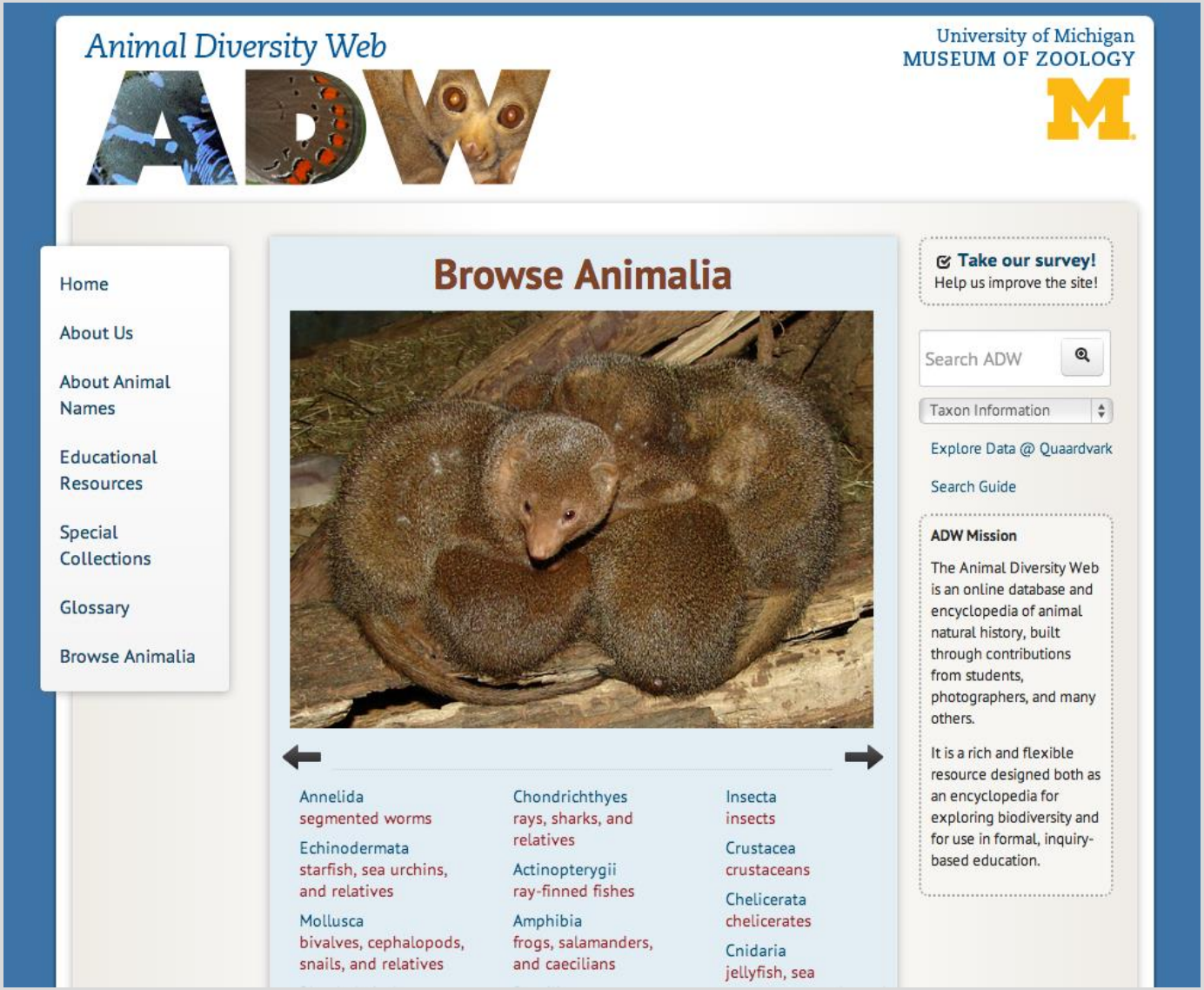
Dive in

Ask questions

Answer questions

Large and small





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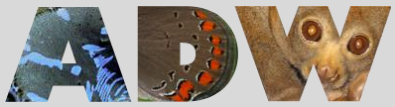
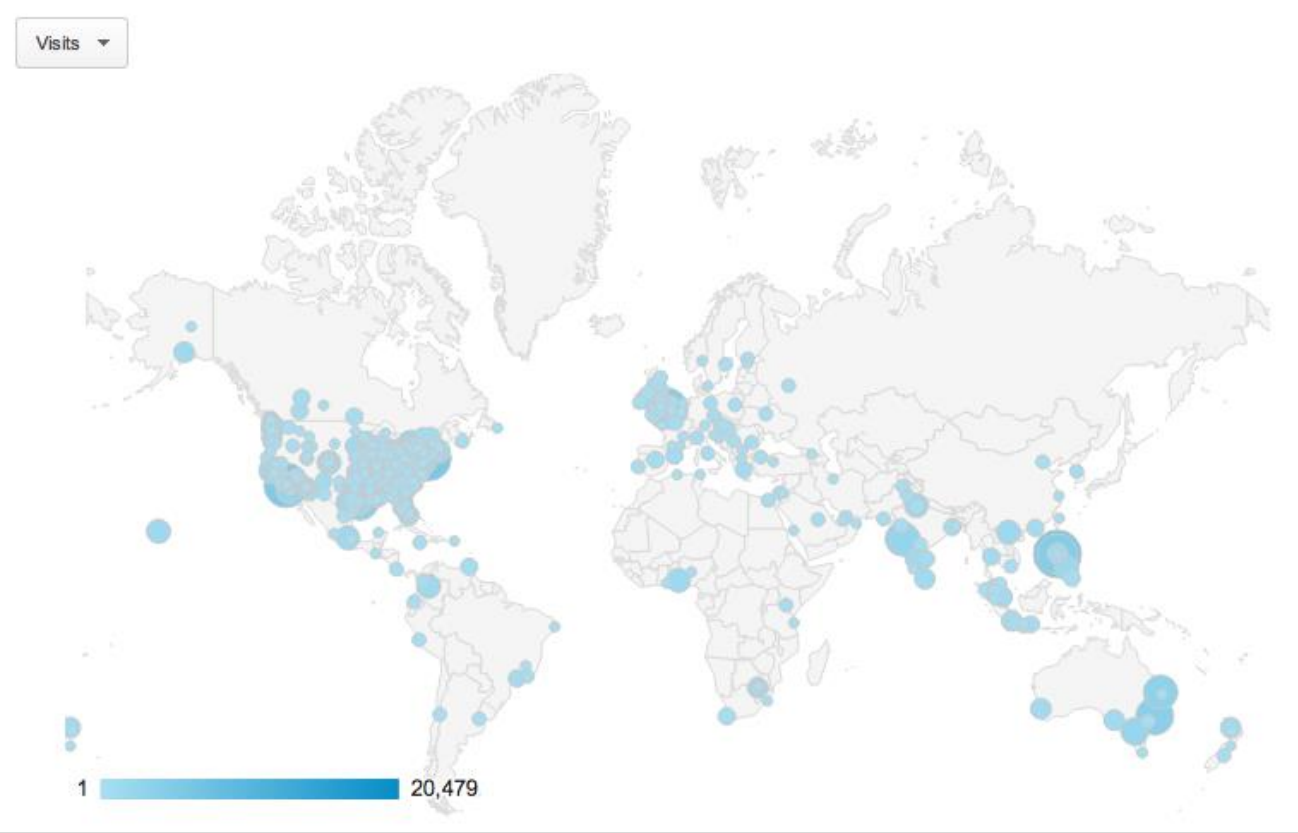


The Animal Diversity Web is:

- a global natural history database
- built by students
- using museum data
- that supports student inquiry

- a global natural history database

1.4 million pages monthly to over 400,000 unique visitors



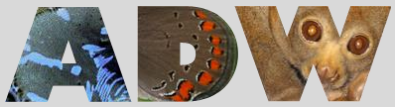
ADW ADW ADW ADW

- built by students

77 institutions, hundreds of courses, over 3500 student authors

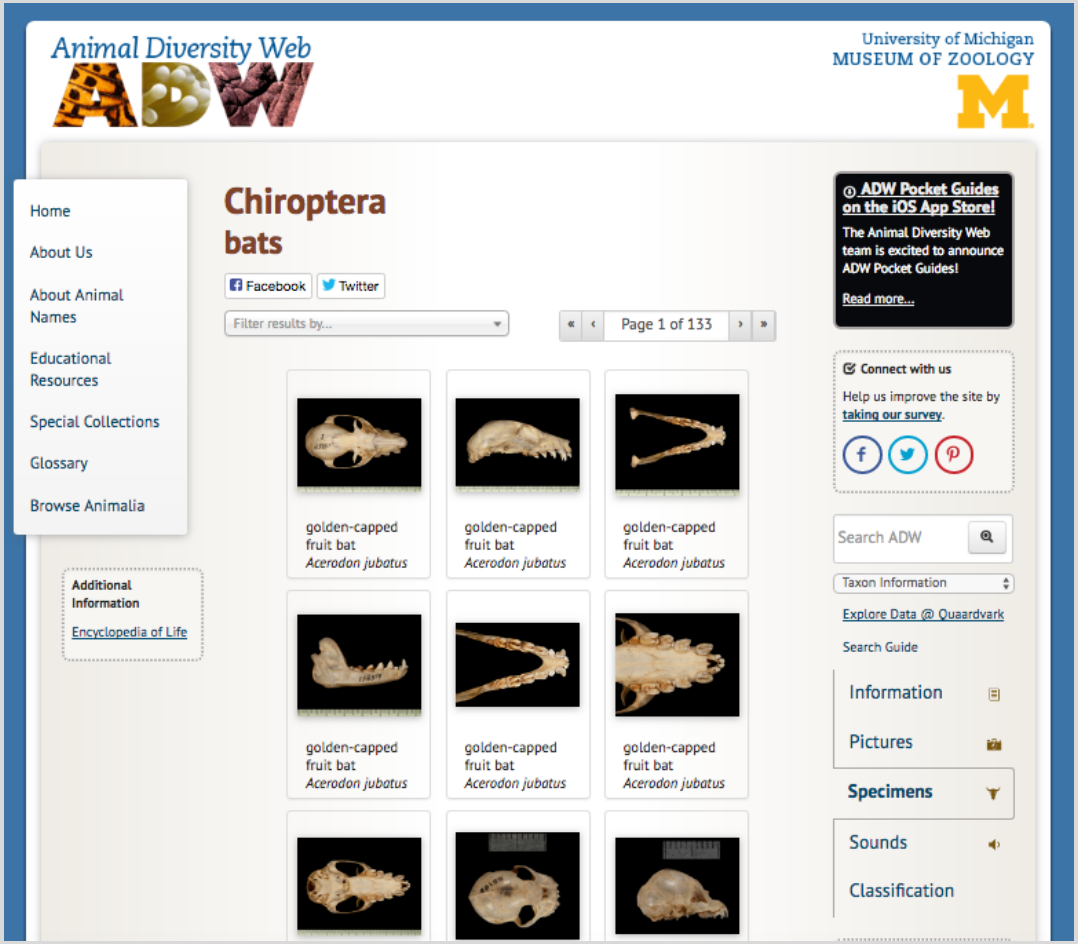
> 4000 species, 400 higher taxa, 19,000 live animal images

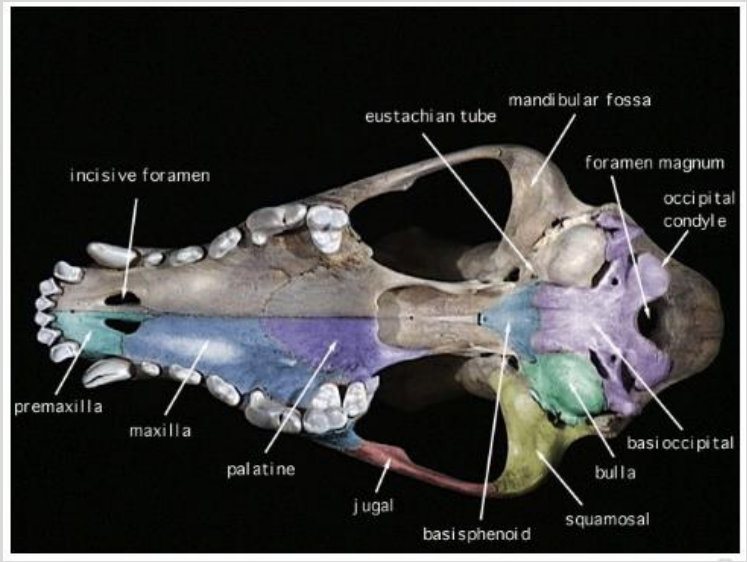
Missouri State University - BIO 676 - 2016				
Siren intermedia *revision*	Amphibia	rav13 Sickler, Stephanie sickler13@live.missouristate.edu	2016-12-21 11:52	submitted
Stony Brook University - WSE 187 - 2015				
Ectophylla alba	Mammalia	loloyohe Yohe, Laurel laurel.yohe@stonybrook.edu	2015-09-02 12:00	in-progress
University of Wisconsin - Stevens Point - Biol 490 - 2016				
Ambystoma annulatum *revision*	Amphibia	lport401 Porter, Laura lport401@uwsp.edu	2016-05-18 12:37	pending
Tyrannus savana	Aves	tschi627 Schirmer, Taylor tschi627@uwsp.edu	2016-05-10 17:52	submitted
Zosterops japonicus	Aves	azuel960 Zuelke, Amber azuel960@uwsp.edu	2016-05-05 17:53	submitted
Coquillettidia perturbans	Insecta	kbead121 Beadle, Katherine kjbeadle26@gmail.com	2016-05-18 14:39	pending
Schistosoma mekongi	Trematoda	zlind030 Lind, Zachary zlind030@uwsp.edu	2016-05-04 17:13	submitted

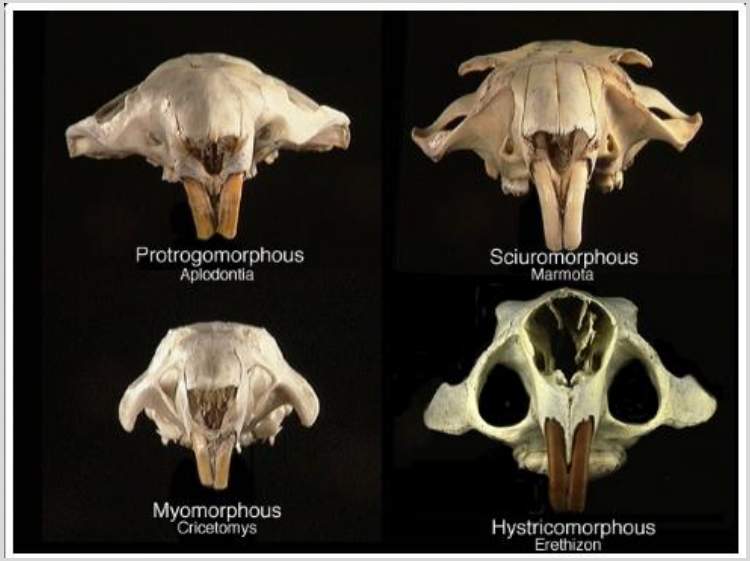


- using museum data

7,500 specimen images



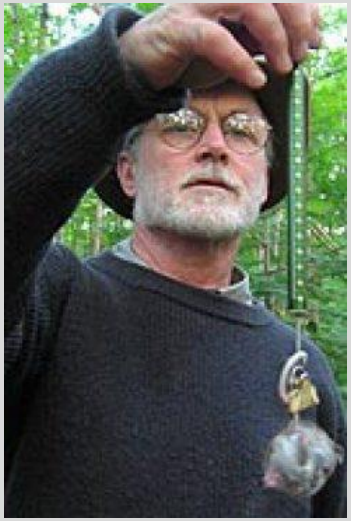


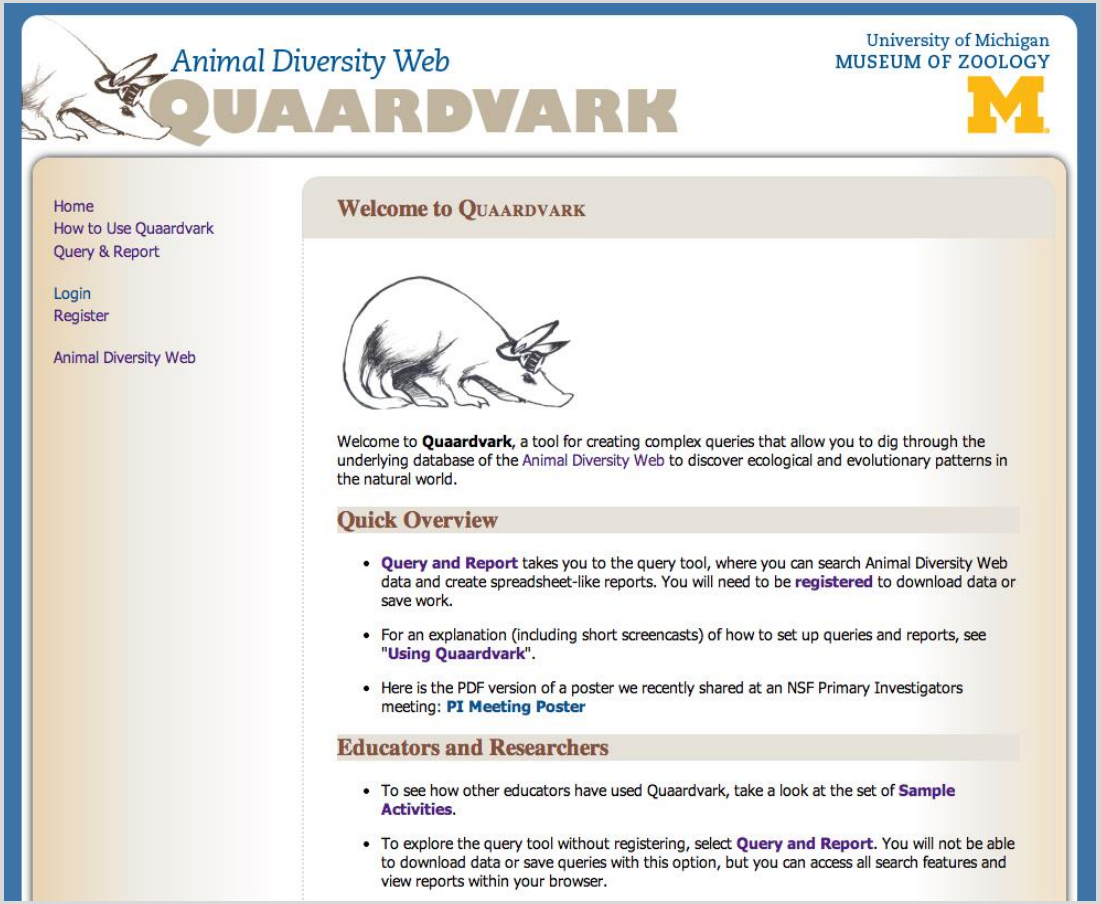


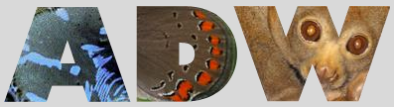
- that supports student inquiry

Over 30 institutions, thousands of students, and more than 30 prepared activities

Dr. Phil Myers



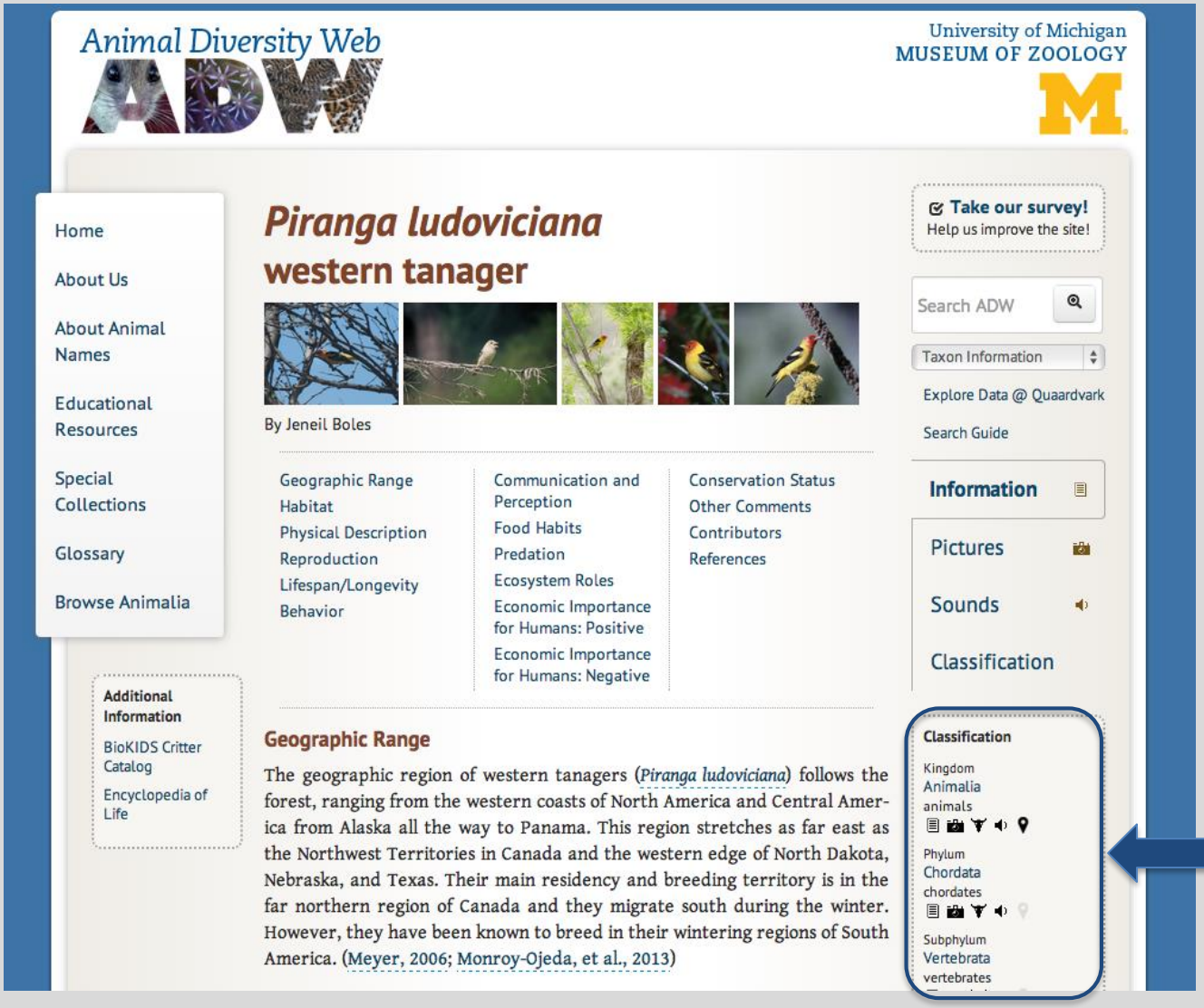




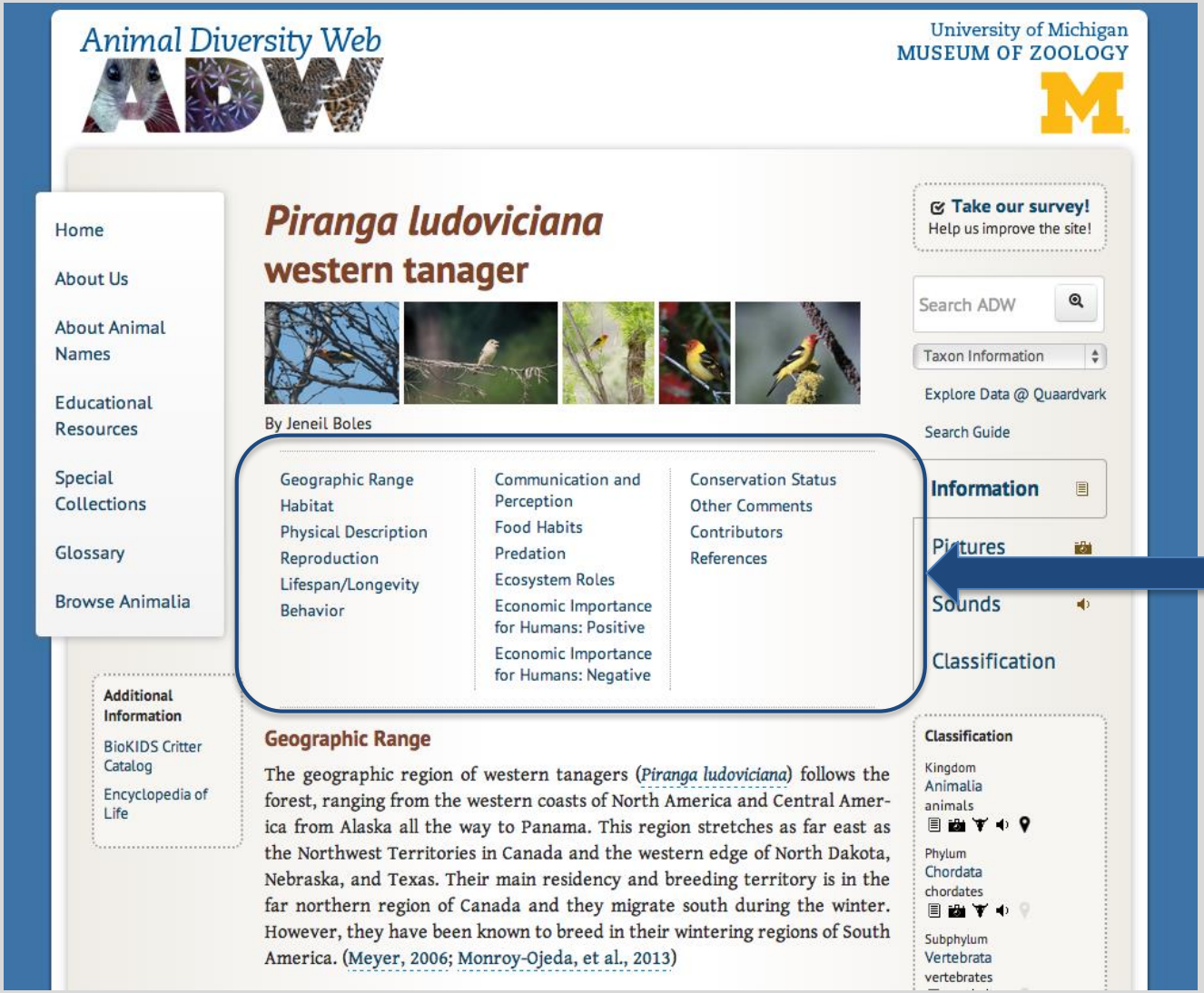
What goes into supporting flexible querying?

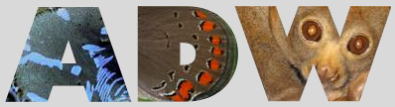
- taxonomic skeleton
- a fully structured database
- controlled vocabulary keywords
- data fields

- taxonomic skeleton



- a fully structured database





- controlled vocabulary keywords

Some key physical features

- [x] Endothermic
- [ ] Heterothermic
- [ ] Homoiothermic
- [x] Bilateral symmetry
- [ ] Polymorphic
- [ ] Poisonous (bad news if you bite it)
- [ ] Venomous (bad news if it bites you)

Sexual dimorphism

- [x] Sexes alike
- [ ] Female larger
- [ ] Male larger
- [ ] Sexes colored or patterned differently
- [ ] Female more colorful
- [ ] Male more colorful
- [ ] Sexes shaped differently
- [ ] Ornamentation (antlers, wattles, etc.)

Key behaviors

- [x] arboreal (lives in trees)
- [ ] scansorial (specialized for climbing in trees)
- [ ] cursorial (specialized for running)
- [ ] terricolous (lives on the ground)
- [ ] fossorial (specialized for burrowing under ground)
- [ ] troglophilic (breeds and thrives in caves)
- [ ] flies
- [ ] glides
- [ ] saltatorial (specialized for jumping and hopping)
- [ ] natatorial (specialized for swimming)
- [x] diurnal (active during the day)
- [ ] nocturnal (active at night)
- [ ] crepuscular (active at dusk and dawn)
- [ ] parasite
- [x] motile (able to move around)
- [ ] nomadic (moves throughout a large range year-round)
- [ ] migratory (moves seasonally between different regions)
- [ ] sedentary (mainly stays in one general area)
- [ ] hibernation (inactive during the winter)
- [ ] aestivation (dormant during hot weather or times of little food)
- [ ] daily torpor (dormant for a part of each day)
- [ ] solitary
- [x] territorial (area defended by an animal or group)
- [ ] social (lives mainly in a group)
- [ ] colonial (lives in large groups)
- [ ] dominance hierarchies

- data fields

Longest known lifespan in wild

Low:	
High:	5.1
Average:	
Units:	years

Longest known lifespan in captivity

Low:	
High:	
Average:	
Units:	hours

Expected lifespan in wild

Low:	
High:	
Average:	
Units:	hours

Expected lifespan in captivity

Low:	
High:	
Average:	
Units:	hours

Eggs per season

Low:	6
High:	8
Average:	

Time to hatching

Low:	
High:	
Average:	11
Units:	days

Birth Mass

Low:	
High:	
Average:	1.1
Units:	g

Time to fledging

Low:	9
High:	13
Average:	
Units:	minutes

Time to independence

Low:	15
High:	23
Average:	
Units:	days

Age at sexual or reproductive maturity (female)

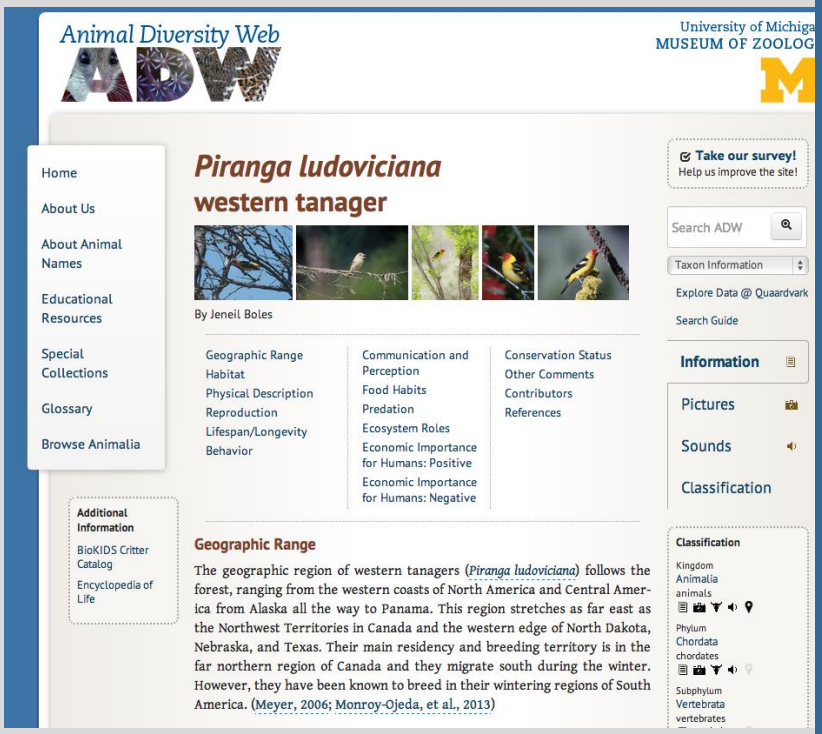
Low:	
High:	
Average:	365
Units:	days

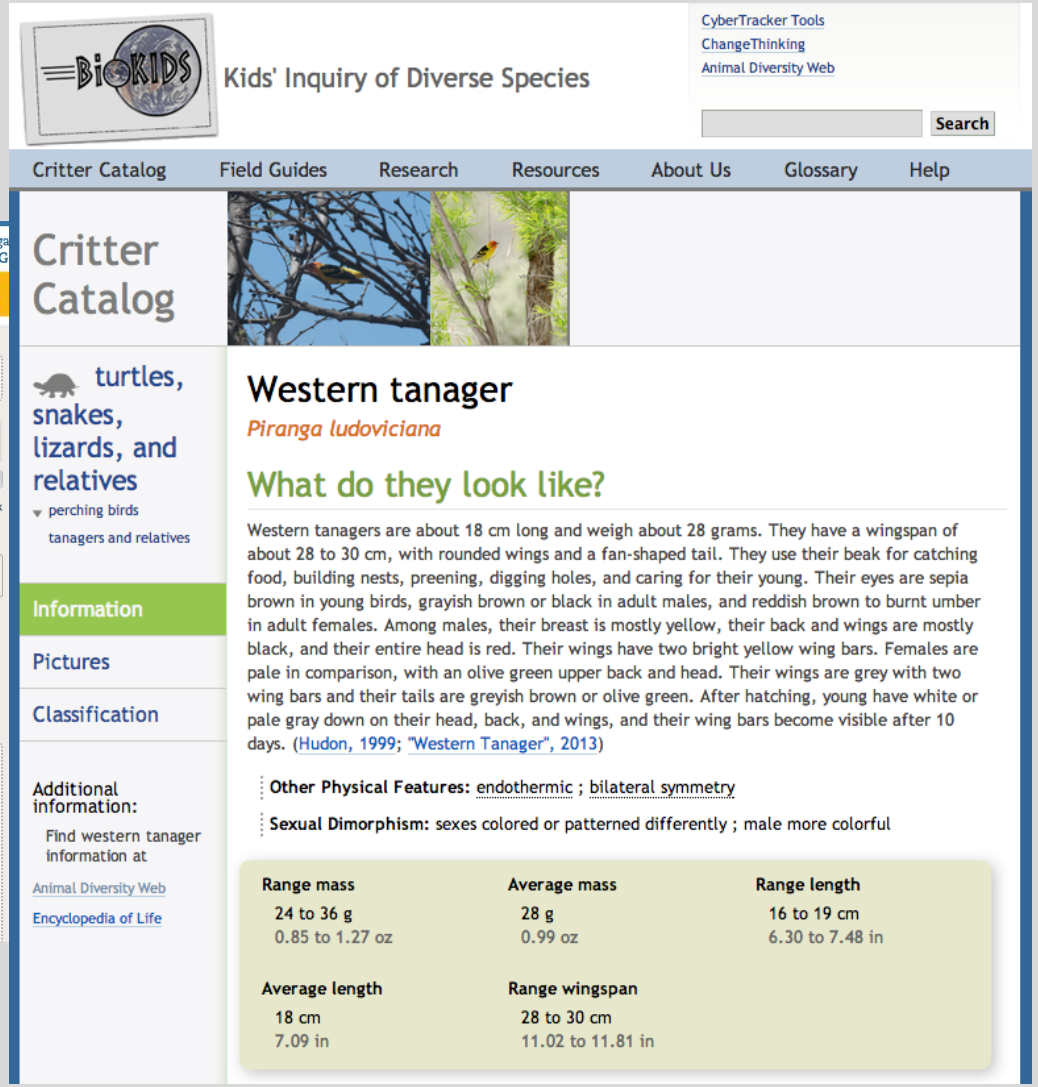
The result:

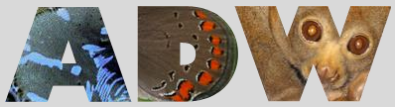
- flexible presentation of content
- flexible queries to explore hypotheses

- flexible presentation of content

BioKIDS Critter Catalog

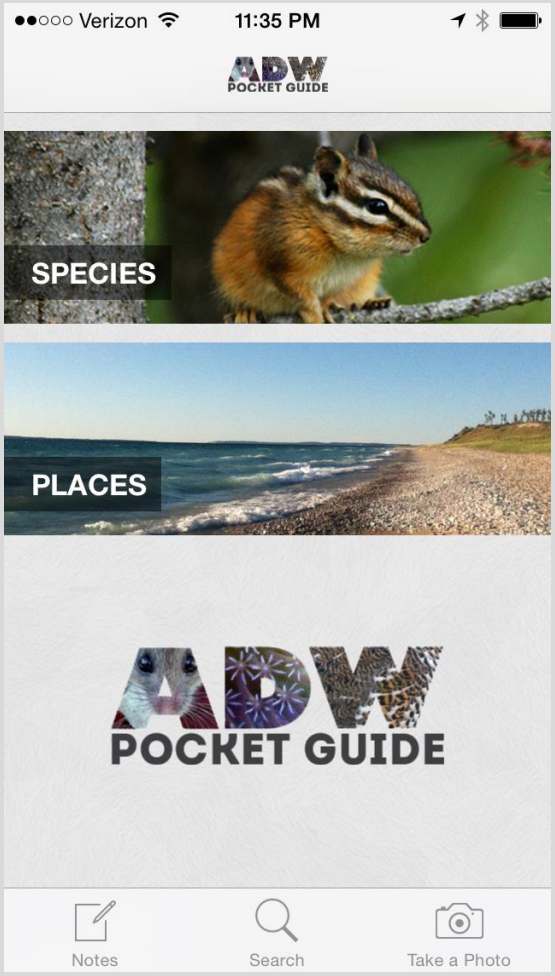


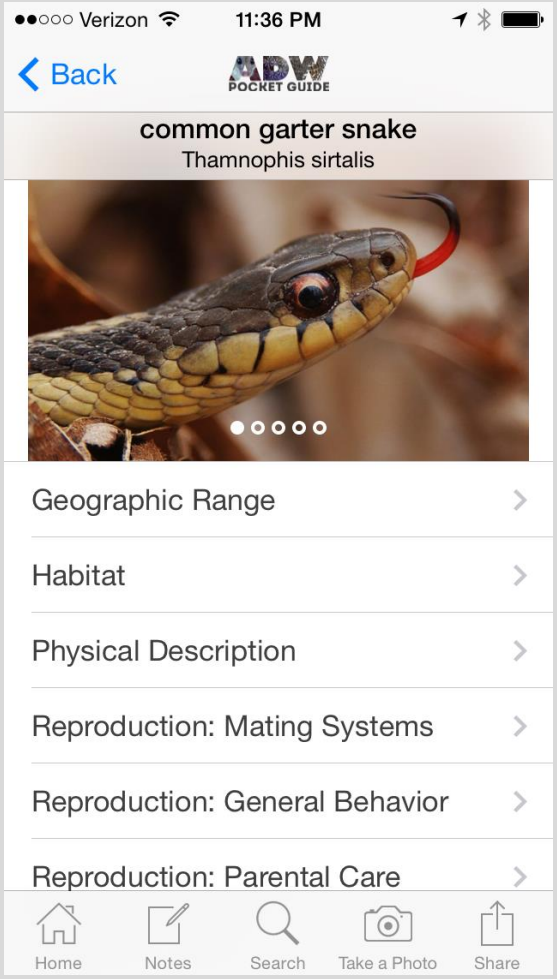


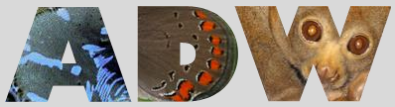


- flexible presentation of content

Customized pocket guides







- flexible queries to explore hypotheses

Animal Diversity Web

QUAARDVARK

Hide Query Setup | Show Backpack | Save to Backpack | Home | Usin

Query *What group of animals are you interested in searching?*

Animal Group | "Animalia" | Edit | Add condition | Delete

Add animal group

Report *What do you want to know about them?*

Taxonomic Ranks > Species

Taxonomic Ranks > Class | ... | Edit | Move Up | Move Down | Delete

Add more data

Reset Form

Submit

ADW ADW ADW ADW

- flexible queries to explore hypotheses

Sample Activities

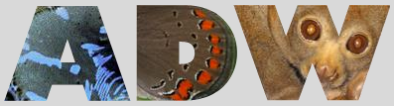
ADW project staff and collaborating faculty have created a suite of learning activities that use data from the Animal Diversity Web, extracted with Quaardvark. In each activity students construct their own searches and extract data sets that are large enough for them to find patterns. Below is a list of activities suitable for different types of undergraduate courses, followed by a full list of activities. Activity titles link to individual pages with downloadable activity documents.

Suitable for introductory biology students:

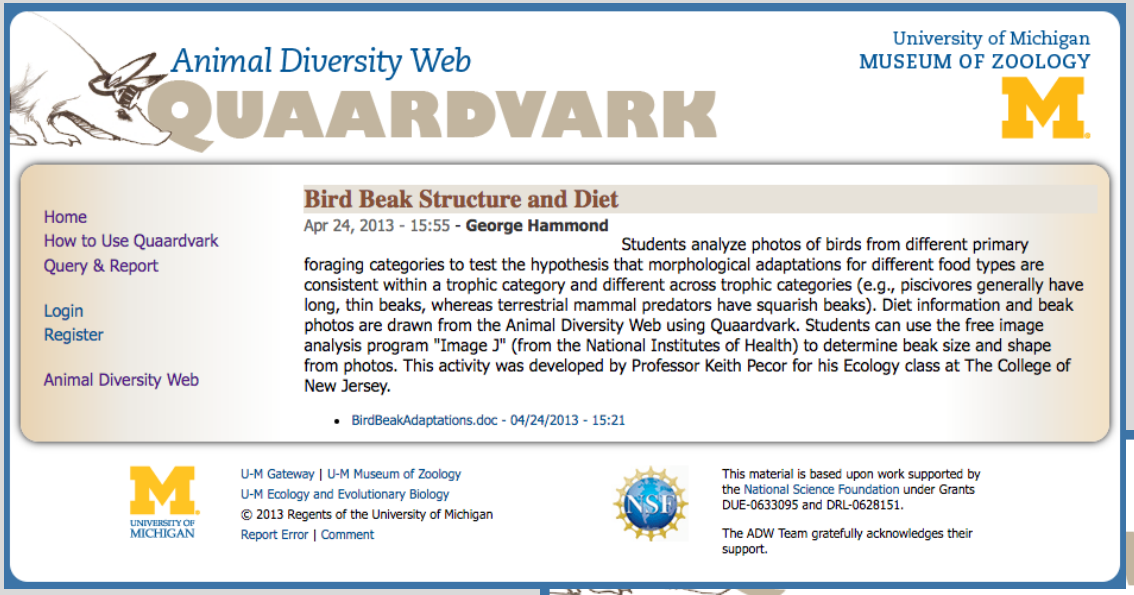
- *An Introduction to the Animal Diversity Web and Quaardvark*
- *Taxonomic Diversity and the Environment*
- *Introduction to Data Analysis*
- *Life History Impacts on Number of Offspring*
- *Form and Function*
- *Generalized Sexual Dimorphism And Mating System Exercise*
- *Mass and Lifespan in Aves*
- *Sociality And Habitat In Aves*
- *Patterns in Life Histories and Conservation Risk*
- *Ecotree Exercise*
- *Endangered Species Lab*
- *Terrestrial/Aquatic Comparisons*
- *Relating Natural History Traits to Basal Metabolic Rate*
- *Body Mass and Basal Metabolic Rate in Birds and Mammals*

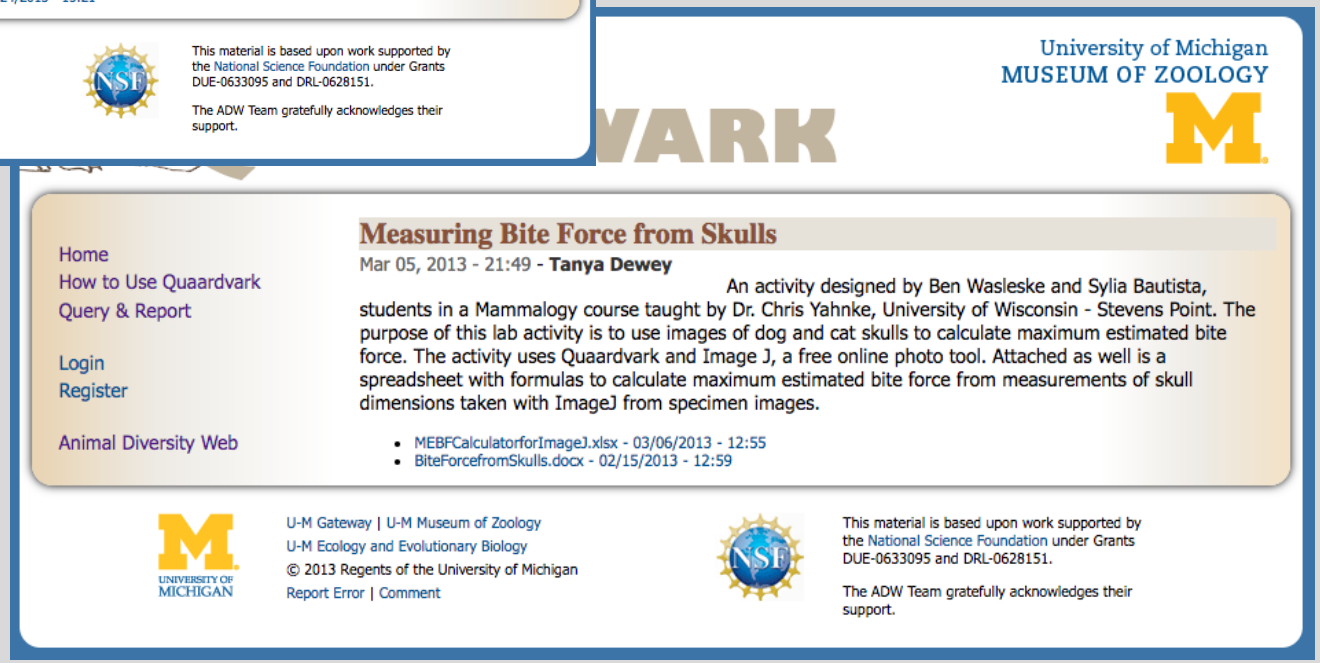
Suitable for ecology, conservation, wildlife classes:

- *An Introduction to the Animal Diversity Web and Quaardvark*
- *Taxonomic Diversity and the Environment*
- *Introduction to Data Analysis*

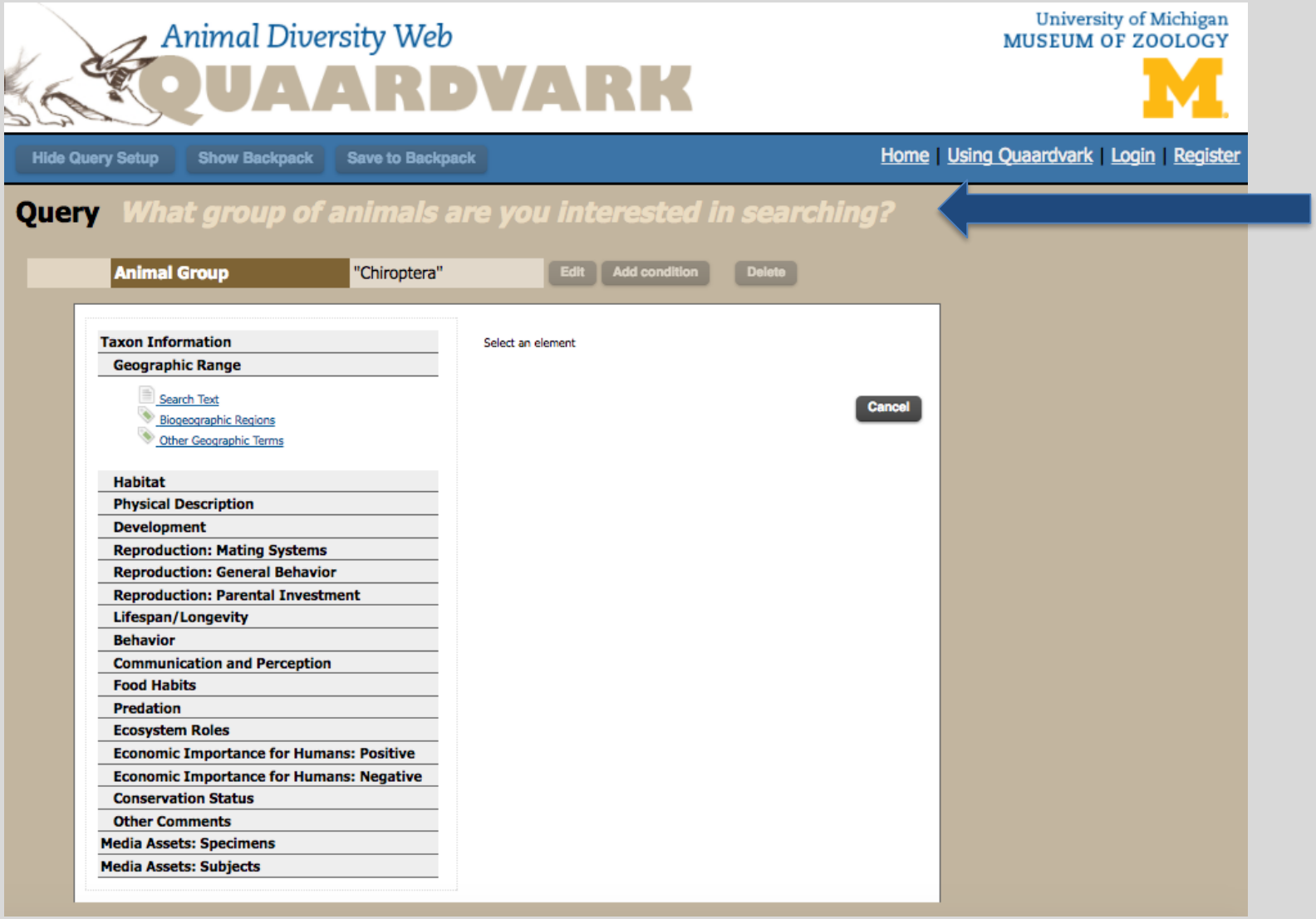


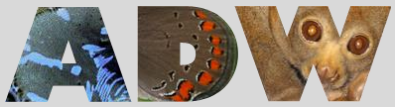
- flexible queries to explore hypotheses





- flexible queries to explore hypotheses





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Hide Query Setup | Show Backpack | Save to Backpack | Home | Using Quaardvark | Logout

Query *What group of animals are you interested in searching?*

Animal Group "Chiroptera" Edit | Add condition | Delete

Taxon Information
Geographic Range
- Search Text
- Biogeographic Regions
- Other Geographic Terms

Habitat
Physical Description
Development
Reproduction: Mating Systems
Reproduction: General Behavior
Reproduction: Parental Investment
Lifespan/Longevity
Behavior
Communication and Perception
Food Habits
Predation
Ecosystem Roles
Economic Importance for Humans: Positive
Economic Importance for Humans: Negative
Conservation Status
Other Comments
Media Assets: Specimens
Media Assets: Subjects

Biogeographic Regions

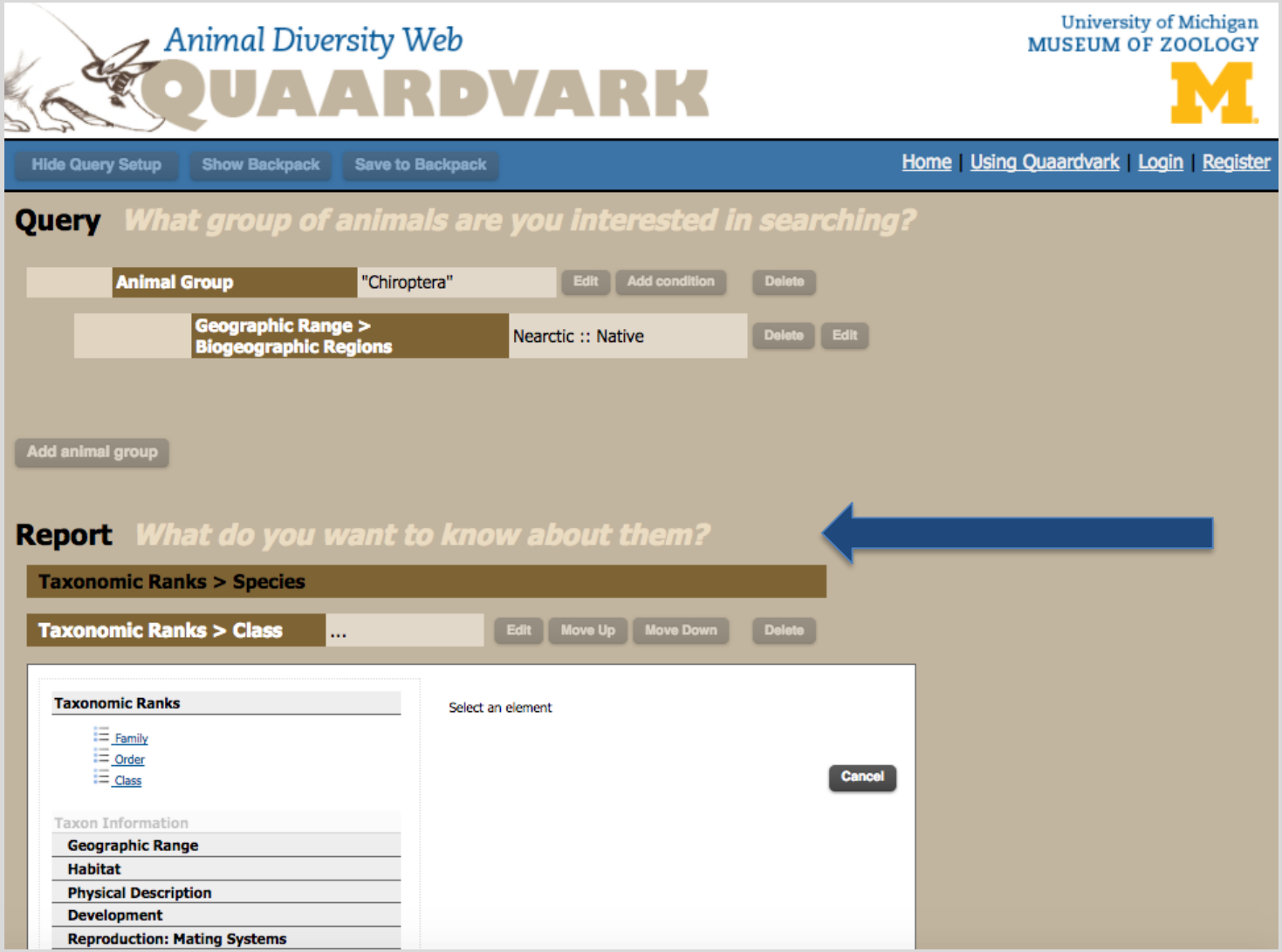
Nearctic (Introduced, Native ✓)	Antarctica (Introduced, Native)	
Palearctic (Introduced, Native)	Oceanic Islands (Introduced, Native)	
Oriental (Introduced, Native)	Arctic Ocean (Introduced, Native)	
Ethiopian (Introduced, Native)	Indian Ocean (Introduced, Native)	
Neotropical (Introduced, Native)	Atlantic Ocean (Introduced, Native)	
Australian (Introduced, Native)	Pacific Ocean (Introduced, Native)	
	Mediterranean Sea (Introduced, Native)	

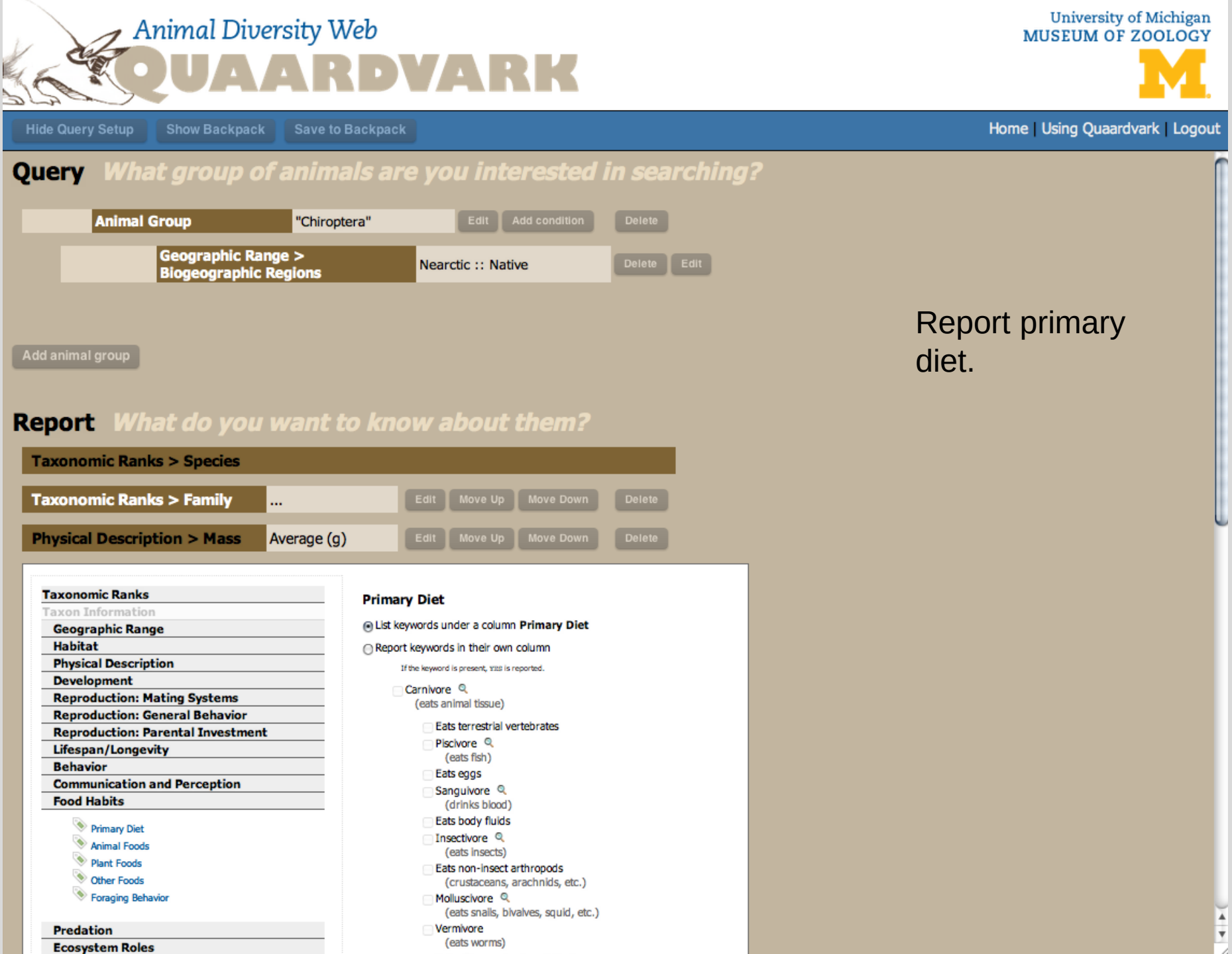
Select Introduced | Select Native

Cancel | Save Changes

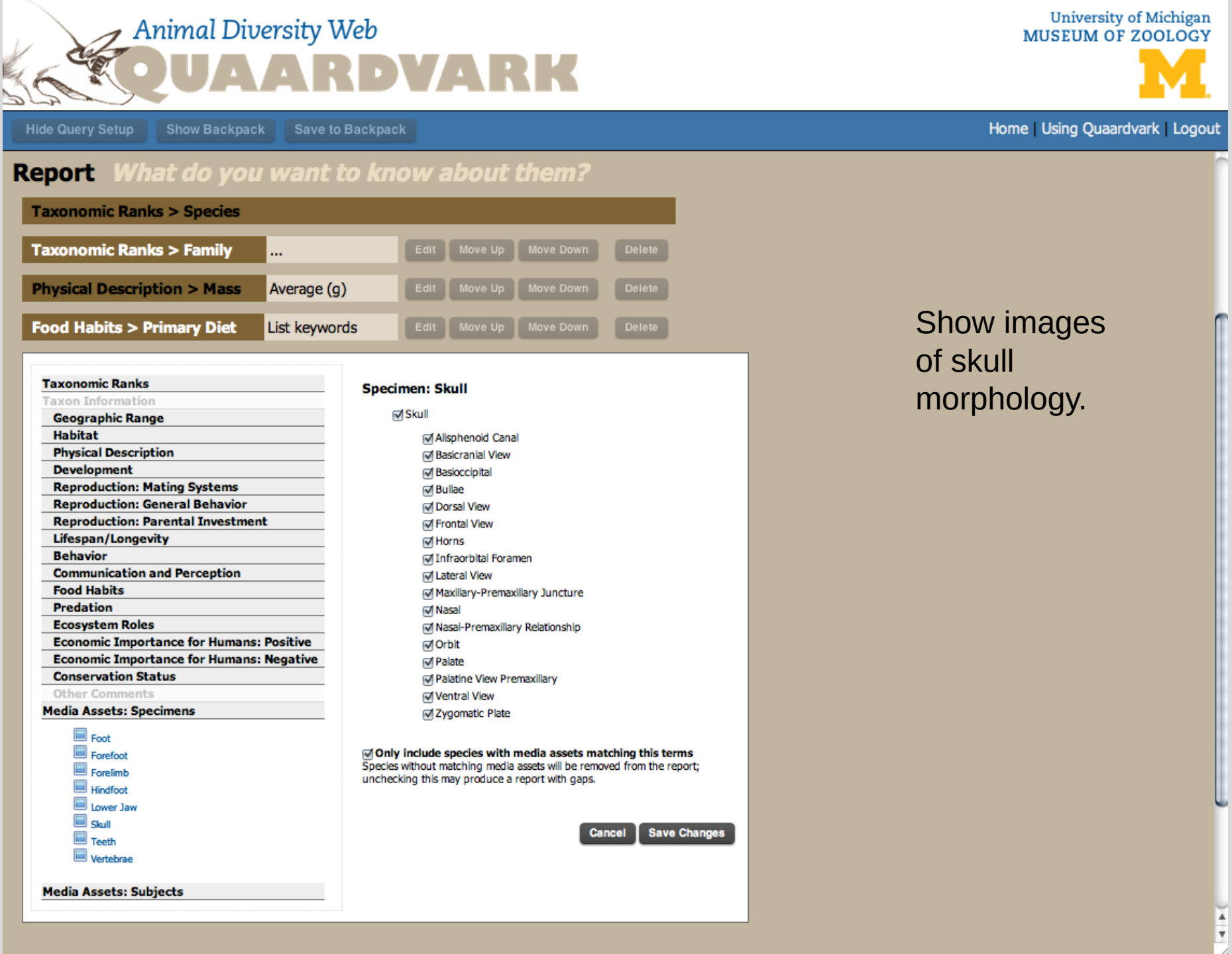
Query for bats native to the Nearctic.

- flexible queries to explore hypotheses





Report primary diet.



Show images of skull morphology.

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Hide Query Setup | Show Backpack | Save to Backpack | Home | Using Quaardvark | Logout

Query *What group of animals are you interested in searching?*

	Animal Group	"Chiroptera"	Edit	Add condition	Delete

Add animal group

Select "submit."

Report *What do you want to know about them?*

Taxonomic Ranks > Species					
Taxonomic Ranks > Family	...	Edit	Move Up	Move Down	Delete
Geographic Range > Biogeographic Regions	List keywords	Edit	Move Up	Move Down	Delete
Physical Description > Mass	Average (g)	Edit	Move Up	Move Down	Delete
Food Habits > Primary Diet	List keywords	Edit	Move Up	Move Down	Delete
Media Assets: Specimens > Specimen: Skull	Skull :: Ventral View	Edit	Move Up	Move Down	Delete

Add more data

Reset Form | Submit

Please keep in mind that Animal Diversity Web data are incomplete. We rely on contributions from students for our accounts and data, and there are sometimes inaccuracies or missing information. We're working to provide a rich source of data for the more than 3000 animal taxa represented here. If you find errors, we would be grateful if you would report them.

Animal Diversity Web
QUAARDVARK

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Show Query Setup | Show Backpack | Save to Backpack | Download | 38 matches | Home | Using Quaardvark | Logout

Image sizes: 1 2 3 4 | Hide selected | See selected | See all | Rotate Table

Species	Antrozous pallidus	Choeronycteris mexicana	Corynorhinus rafinesquii	Corynorhinus townsendii	Desmodus rotundus	Diphylla ecaudata	Eptesicus fuscus	Eumops pe
Family	Vespertilionidae	Phyllostomidae	Vespertilionidae	Vespertilionidae	Phyllostomidae	Phyllostomidae	Vespertilionidae	Molossidae
Mass - g	22.5	25	10	9	32.5	35	23	57
Primary Diet	• Carnivore • Carnivore :: Insectivore	• Herbivore • Herbivore :: Frugivore • Herbivore :: Nectarivore	• Carnivore • Carnivore :: Insectivore	• Carnivore • Carnivore :: Insectivore	• Carnivore • Carnivore :: Sanguivore		• Carnivore	• Carnivor • Carnivor
Skull :: Lateral View								
Skull :: Ventral View								

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Report is presented in the browser window and is downloadable.

- flexible queries to explore hypotheses

- flexible queries to explore hypotheses

Animal Diversity Web
QUAARDVARK

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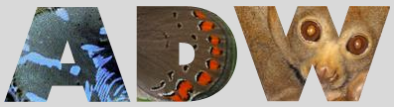
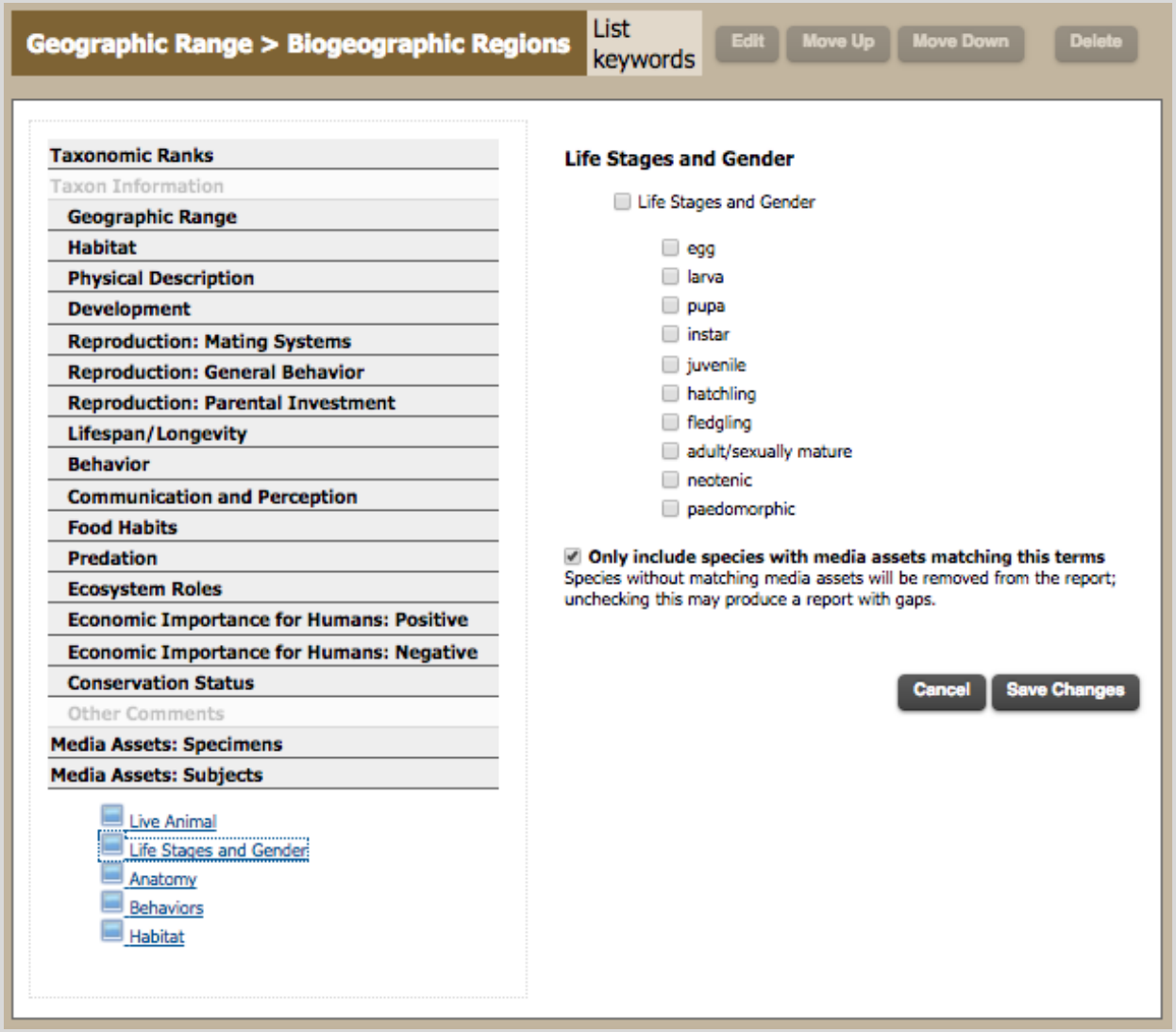
Show Query Setup | Show Backpack | Save to Backpack | « 1 - 200 / 715 matches » | Home | Using Quaardvark | Login | Register

Species	Family	Mass - average - g	Lifespan (wild, undetermined) - undetermined - average - years
Acinonyx jubatus	Felidae	46500	8
Acrobates pygmaeus	Acrobatidae	13	4
Aepyceros melampus	Bovidae	52500	15
Aepyprymnus rufescens	Potoroidae	2.48	6
Ailuropoda melanoleuca	Ursidae	102500	12.5
Ailurus fulgens	Ailuridae	4950	14
Akodon azarae	Cricetidae	19	0.79
Alcelaphus buselaphus	Bovidae	137500	20
Alces alces	Cervidae	520500	22
Alces americanus	Cervidae	435000	10
Allactodipus bobrinskii	Dipodidae	65	2.5
Allenopithecus nigroviridis	Cercopithecidae	4702.5	23
Alouatta guariba	Atelidae		17.5
Alouatta palliata	Atelidae	6000	20
Alouatta pigra	Atelidae	8900	20
Alouatta seniculus	Atelidae	5500	25
Ammodorcas clarkei	Bovidae	28500	11
Ammospermophilus harrisii	Sciuridae	122	3
Ammospermophilus nelsoni	Sciuridae	155	0.67
Ammotragus lervia	Bovidae	105000	10
Antechinomys laniger	Dasyuridae	25	5.58
Antidorcas marsupialis	Bovidae	39500	20
Antilocapra americana	Antilocapridae	53500	16
Antilope cervicapra	Bovidae	37500	15
Antrozous pallidus	Vespertilionidae	22.5	9
Aonyx capensis	Mustelidae	15800	11
Aotus nigriceps	Aotidae	750	11
Aotus trivirgatus	Aotidae	800	20
Aplodontia rufa	Aplodontiidae	1125	10
Apodemus sylvaticus	Muridae	23.4	1
Arctictis binturong	Viverridae	14500	18
Arctocebus calabarensis	Lorisidae	365.5	13



- image queries of live animals using controlled vocabulary



Dendroica caerulescens	Parulidae	• Nearctic • Nearctic :: Native • Neotropical • Neotropical :: Native	
Dendroica cerulea	Parulidae	• Nearctic • Nearctic :: Native • Neotropical • Neotropical :: Native	
Dendroica coronata	Parulidae	• Nearctic • Nearctic :: Native • Neotropical • Neotropical :: Native	
Dendroica kirtlandii	Parulidae	• Nearctic • Nearctic :: Native • Neotropical • Neotropical :: Native	

Nearly limitless inquiries

- students pose hypotheses and explore data on their own
- supports data analysis skills
- supports observation and measurement of specimens

Additional possibilities

- Integrate with other databases (collection, image, range maps, etc.)

External Information Resources (NCBI LinkOut)

LinkOut	Subject	LinkOut Provider
Myotis lucifugus	taxonomy/phylogenetic	Animal Diversity Web

Evidence of efficacy

- exercises built and tested in over 30 classrooms at 20+ institutions
- Over 3000 students evaluated, pre/post-assessment via participant perception indicator tools
- significant increases in student confidence in their ability to formulate and answer scientific hypotheses and manipulate data

Spring 2018

QUBES
The Power of Biology × Math × Community

- QUBES Faculty Mentoring Network around using ADW querying in undergraduate classrooms – come join us!

Thank you!

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