NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

SCHOOL OF AGRICULTURE AND NATURAL RESOURCE SCIENCES

DEPARTMENT OF NATURAL RESOURCE SCIENCES

QUALIFICATION: **BACHELOR OF NATURAL RESOURCE MANAGEMENT**	
QUALIFICATION CODE: **07BNRS**	LEVEL: **6**
COURSE CODE: **BRM622S**	COURSE NAME: **BASIC RESEARCH METHODS**
DATE: **NOVEMBER 2024**	
DURATION: **3 HOURS**	MARKS: **100**

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	Dr. Mark C. Bilton
MODERATOR:	Prof. Ben Strohbach

INSTRUCTIONS
1. Answer ALL the questions. 2. Write clearly and neatly. 3. Number your answers clearly. 4. Show your detailed work for calculations.

PERMISSIBLE MATERIALS

1. Calculator

THIS QUESTION PAPER CONSISTS OF 8 PAGES (Excluding this front page)

Question 1 (Literature searching)

Below is a Zotero report (reference management software output) containing 6x articles labelled from A – F. *Please note, for the purpose of the exam, the abstracts have been shortened and some authors have been removed.*

A)	**Ecological responses to recent climate change** **Item Type** Journal Article **Author** Gian-Reto Walther **Author** Eric Post **Author** Peter Convey **Author** Annette Menzel **Author** Camille Parmesan **Author** Trevor J. C. Beebee **Author** Jean-Marc Fromentin **Author** Ove Hoegh-Guldberg **Author** Franz Bairlein **Abstract** There is now ample evidence of the ecological impacts of recent climate change, from polar terrestrial to tropical marine environments. The responses of both flora and fauna span an array of ecosystems and organizational hierarchies, from the species to the community levels.... **Date** 2002-03-01 **URL** https://doi.org/10.1038/416389a **Volume** 416 **Pages** 389-395 **Publication** Nature **DOI** 10.1038/416389a **Issue** 6879 **Journal Abbr** Nature **ISSN** 1476-4687 **Date Added** 20/10/2024, 15:50:30 **Modified** 20/10/2024, 15:50:30
B)	**Global Biodiversity Scenarios for the Year 2100** **Item Type** Journal Article **Author** Osvaldo E. Sala **Author** F. Stuart Chapin **Author** Juan J. Armesto **Author** Eric Berlow **Author** Janine Bloomfield

	Author	Rodolfo Dirzo
	Author	Brian H. Walker
	Author	Marilyn Walker
	Author	Diana H. Wall
	Abstract	Scenarios of changes in biodiversity for the year 2100 can now be developed based on scenarios of changes in atmospheric carbon dioxide, climate, vegetation, and land use and the known sensitivity of biodiversity to these changes...
	Date	2000-03-10
	URL	https://doi.org/10.1126/science.287.5459.1770
	Accessed	20/10/2024, 02:00:00
	Extra	Publisher: American Association for the Advancement of Science
	Volume	287
	Pages	1770-1774
	Publication	Science
	DOI	10.1126/science.287.5459.1770
	Issue	5459
	Date Added	20/10/2024, 15:50:30
	Modified	20/10/2024, 15:50:30
C)	**Global Desertification: Building a Science for Dryland Development**	
	Item Type	Journal Article
	Author	James F. Reynolds
	Author	D. Mark Stafford Smith
	Author	Eric F. Lambin
	Author	B. L. Turner
	Author	Michael Mortimore
	Author	Rik Leemans
	Author	Tim Lynam
	Author	Fernando T. Maestre
	Author	Miguel Ayarza
	Author	Brian Walker
	Abstract	In this millennium, global drylands face a myriad of problems that present tough research, management, and policy challenges. Recent advances in dryland development, however, together with the integrative approaches of global change and sustainability science...
	Date	2007-05-11
	URL	https://doi.org/10.1126/science.1131634
	Accessed	20/10/2024, 02:00:00
	Extra	Publisher: American Association for the Advancement of Science
	Volume	316
	Pages	847-851
	Publication	Science

	DOI	10.1126/science.1131634
	Issue	5826
	Date Added	20/10/2024, 15:50:30
	Modified	20/10/2024, 15:50:30
D)	**Plants and climate change: complexities and surprises**	
	Item Type	Journal Article
	Author	Camille Parmesan
	Author	Mick E. Hanley
	Abstract	Anthropogenic climate change (ACC) will influence all aspects of plant biology over coming decades. Many changes in wild species have already been well-documented as a result of increased atmospheric CO2 concentrations, warming climate and changing precipitation regimes....
	Date	2015-11-01
	URL	https://doi.org/10.1093/aob/mcv169
	Accessed	20/10/2024, 02:00:00
	Volume	116
	Pages	849-864
	Publication	Annals of Botany
	DOI	10.1093/aob/mcv169
	Issue	6
	ISSN	0305-7364
	Date Added	20/10/2024, 15:50:30
	Modified	20/10/2024, 15:50:30
E)	**Predicting Chronic Climate-Driven Disturbances and Their Mitigation**	
	Item Type	Journal Article
	Author	Nate G. McDowell
	Author	Sean T. Michaletz
	Author	Katrina E. Bennett
	Author	Kurt C. Solander
	Author	Chonggang Xu
	Author	Reed M. Maxwell
	Author	Richard S. Middleton
	Abstract	Society increasingly demands the stable provision of ecosystem resources to support our population. Resource risks from climate-driven disturbances, including drought, heat, insect outbreaks, and wildfire, are growing as a chronic state of disequilibrium results from increasing temperatures and a greater frequency of extreme events....
	Date	2018-01-01
	URL	https://www.sciencedirect.com/science/article/pii/S0169534717302616
	Volume	33

	Pages	15-27
	Publication	Trends in Ecology & Evolution
	DOI	10.1016/j.tree.2017.10.002
	Issue	1
	ISSN	0169-5347
	Date Added	20/10/2024, 15:50:30
	Modified	20/10/2024, 15:50:30
F)	**Species diversity: from global decreases to local increases**	
	Item Type	Journal Article
	Author	Dov F. Sax
	Author	Steven D. Gaines
	Abstract	Current patterns of global change can strongly affect biodiversity at global, regional and local scales. At global scales, habitat destruction and the introduction of exotic species are contributing to declines in species diversity....
	Date	2003-11-01
	URL	https://www.sciencedirect.com/science/article/pii/S0169534703002246
	Volume	18
	Pages	561-566
	Publication	Trends in Ecology & Evolution
	DOI	10.1016/S0169-5347(03)00224-6
	Issue	11
	ISSN	0169-5347
	Date Added	20/10/2024, 15:50:30
	Modified	20/10/2024, 15:50:30

1a) List the articles, using the identifying letters, in the order they would appear in a Bibliography / reference list. (e.g. F, C, D, A, E, B)

[6]

1b) Write article 'F' in the correct format in which it would appear in the bibliography/reference list, using APA7 style *(don't worry about italic formatting, it is important you show which information "should" be included)*

[6]

1c) Below is the text in which the articles were cited....

"Climate change has already had large impacts on plant communities around the world [i)(A; D)] (... ... ; ... ...). Predictions for some ecosystems suggest that they are nearing tipping points, beyond which there is no immediate return, and full scale degradation may set in [(i)(C;E)] (... ...; ... ...). This may be particularly so in regions where climate change and heavy pressure due to land-use change add up to drive ecosystems beyond thresholds [(iii)(B;F)] (... ... ; ... ...).

Write the correct "in text formats" for the articles in the positions i) to iii) as defined by APA 7th edition format. *Super script letters highlight which articles (A-F) should be included in each section – <u>but not necessarily in the correct order</u>.*

i) (...... ;......) [(A;D)]
ii) (...... ;......) [(C;E)]
iii) (...... ;......) [(B;F)]

[6]

1d) Briefly explain how you would find more relevant articles for reading based on those already found in the Zotero report.

[6]

Total marks [[24]]

Question 2 (Observational Study)

On 8 commercial farms in the Waterberg Landscape, you set up a study to ask the broad question "what is the effect of debushing on rangelands ?"

Within this study you observe areas that are non-debushed, treated by chemical debushing techniques, and areas which are thinned mannually.

2a) What treatment levels should be repeated on every farm in order to answer the question well / remove unwanted variance ?

[3]

2b) Name two response variables you would observe in order to answer the broad question?

[2]

2c) How many explanatory variables are included in this study ?

[1]

2d) Name some confounding effects you would take into consideration in the study design ?
i.e. i) things you would try to keep the same ? **[3]**
ii) things you would take extra measures of ? **[3]**

2e) Considering one of your response variables, state one hypothesis you will test ?

[4]

Total marks [[16]]

Question 3 (Experimental study)

On a commercial farm the effects of reduced rainfall and grazing intensity are tested in a fully factorial design i.e. including all combinations of treatment levels. Shelters are erected to reduce the amount and rainfall reaching the ground surface, and areas are cut manually either 2x or 4x per year to simulate grazing intensity. Perennial grass density is measured as a response of rangeland health.

Here there are two treatments/explanatory variables – Rainfall and Grazing intensity.

3a) What controls (if any) would you include in the study in order to test the impact of the stressors on rangeland health ?

[3]

3b) If all combinations of treatment levels are included (including any controls), how many treatment levels are there in total ? Draw a diagram to show all treatments levels included.

[6]

3c) i) Name "the three R's" important to consider in experimental design

[3]

ii) Describe how you would use each of these three R's to set-up the full experiment

[9]

3d) State three hypotheses you would test for in this study ?

[7]

For many "basic" statistical techniques we assume a) normal distribution of the error terms and b) consistent variance across our samples (Homoscedasticity).

3e) In the current experiment, the response variable is "Perennial plant density".

i. Explain why this is unlikely to follow model assumptions when tested. **[3]**
ii. Explain how you might correct for this, so that the error terms DO match model assumptions. **[4]**

Total marks [[35]]

Question 4 (Data presentation and interpretation)

You performed a greenhouse experiment to test how fertilisation affected the growth of the annual grass *Melinis repens* subsp. *grandiflora*. Therefore, you planted seeds into 10 pots which were unfertilised, and 10 pots which contained fertiliser. At the end of the growth cycle, you measured the height of the individuals in centimetres as follows:

	Unfertilized	Fertilized
1	16.5	28.8
2	18.2	45.1
3	25.6	37.2
4	19.5	32.4
5	22.6	31.6
6	27.2	33.1
7	18.8	37.9
8	13.2	33.3
9	25.4	36.5
10	26.3	38.2

4a) Calculate the average for each treatment. Show your calculations. **[4]**

4b) The standard error has been calculated as 4.77 for the unfertilized treatment, and 4.59 for the fertilized treatment. Present your results graphically. **[7]**

4c) In your opinion, is there a significant difference between the two treatments? Explain why you come to this conclusion. **[3]**

4d) You carried out an observational study counting the number of individuals of the grazing tolerant grass *Eragrostis lehmanniana* and the grazing sensitive grass *Antephora pubescens* in 10m x 10m plots. You record the density of both species on either highly grazed areas, or areas of low grazing.

After collecting the data, you perform an ANOVA to test the statistical differences of the different species in the differently grazed areas.

Below is both the figure and ANOVA table for your outputs.

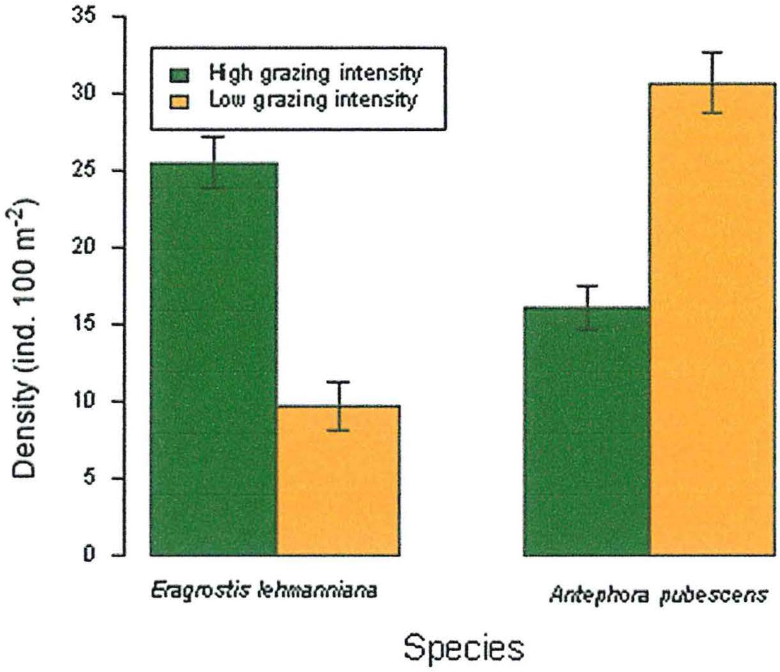

Table 1: ANOVA table for the densities of two grass species counted on areas of different grazing intensity.

Effect	d.f.	F-value	p-value
Species	1	12.19	<0.01
Grazing	1	0.13	0.720
Species x Grazing	1	86.01	<0.0001

Write out a statistical statement suitable for the results section of your thesis, that describes the result of the ANOVA test. **[11]**

Total marks [[25]]

*********** **END OF EXAM** ***********