In [1]:

```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```python
df = pd.read_csv("E:\\Data Science\\8.Machine Learning Algorithms\\2.Classification\\penguins_size.csv")
```

In [3]:

```python
df.head()
```

Out[3]:

	species	island	culmen_length_mm	culmen_depth_mm	flipper_length_mm	body_mass_g
0	Adelie	Torgersen	39.1	18.7	181.0	3750.0
1	Adelie	Torgersen	39.5	17.4	186.0	3800.0
2	Adelie	Torgersen	40.3	18.0	195.0	3250.0
3	Adelie	Torgersen	NaN	NaN	NaN	NaN
4	Adelie	Torgersen	36.7	19.3	193.0	3450.0

In [4]:

```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 344 entries, 0 to 343
Data columns (total 7 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   species            344 non-null    object 
 1   island             344 non-null    object 
 2   culmen_length_mm   342 non-null    float64
 3   culmen_depth_mm    342 non-null    float64
 4   flipper_length_mm  342 non-null    float64
 5   body_mass_g        342 non-null    float64
 6   sex                334 non-null    object 
dtypes: float64(4), object(3)
memory usage: 18.9+ KB
```

In [5]:

```python
df.shape
```

Out[5]:

```
(344, 7)
```

In [6]:

```python
df.isnull().sum()
```

Out[6]:

```
species               0
island                0
culmen_length_mm      2
culmen_depth_mm       2
flipper_length_mm     2
body_mass_g           2
sex                  10
dtype: int64
```

In [7]:
```
df = df.dropna()
```

In [8]:
```
df.shape
```

Out[8]:
```
(334, 7)
```

In [9]:
```
df.head()
```

Out[9]:

	species	island	culmen_length_mm	culmen_depth_mm	flipper_length_mm	body_mass_g
0	Adelie	Torgersen	39.1	18.7	181.0	3750.0
1	Adelie	Torgersen	39.5	17.4	186.0	3800.0
2	Adelie	Torgersen	40.3	18.0	195.0	3250.0
4	Adelie	Torgersen	36.7	19.3	193.0	3450.0
5	Adelie	Torgersen	39.3	20.6	190.0	3650.0

In [10]:
```
df.describe(include="all")
```

Out[10]:

	species	island	culmen_length_mm	culmen_depth_mm	flipper_length_mm	body_mass_
count	334	334	334.000000	334.000000	334.000000	334.00000
unique	3	3	NaN	NaN	NaN	Na
top	Adelie	Biscoe	NaN	NaN	NaN	Na
freq	146	164	NaN	NaN	NaN	Na
mean	NaN	NaN	43.994311	17.160479	201.014970	4209.05688
std	NaN	NaN	5.460521	1.967909	14.022175	804.83612
min	NaN	NaN	32.100000	13.100000	172.000000	2700.00000
25%	NaN	NaN	39.500000	15.600000	190.000000	3550.00000
50%	NaN	NaN	44.500000	17.300000	197.000000	4050.00000
75%	NaN	NaN	48.575000	18.700000	213.000000	4793.75000
max	NaN	NaN	59.600000	21.500000	231.000000	6300.00000

In [11]:
```
df["sex"].unique()
```

Out[11]:
```
array(['MALE', 'FEMALE', '.'], dtype=object)
```

In [14]:
```
df = df[df['sex']!='.']
```

In [15]:
```
df.shape
```

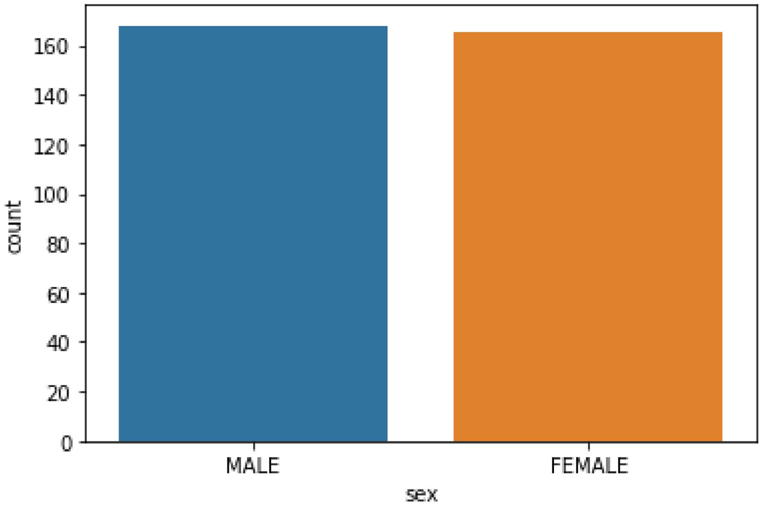
Out[15]:
```
(333, 7)
```

```
In [39]: df.nunique()
```

```
Out[39]: species                3
         island                 3
         culmen_length_mm     163
         culmen_depth_mm       79
         flipper_length_mm     54
         body_mass_g           93
         sex                    2
         dtype: int64
```

```
In [16]: sns.countplot(data = df,x = "sex")
         Male,Female = df["sex"].value_counts()
         print("Number of Male:",Male)
         print("Number of Female:",Female)
         plt.show()
```

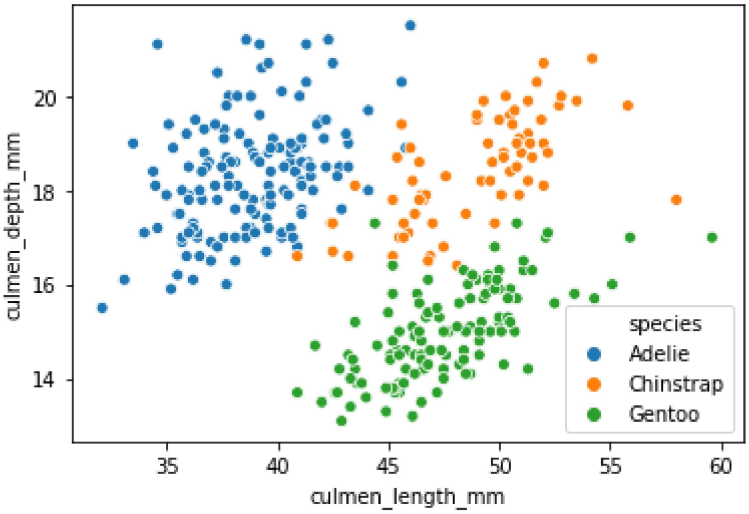
```
Number of Male: 168
Number of Female: 165
```



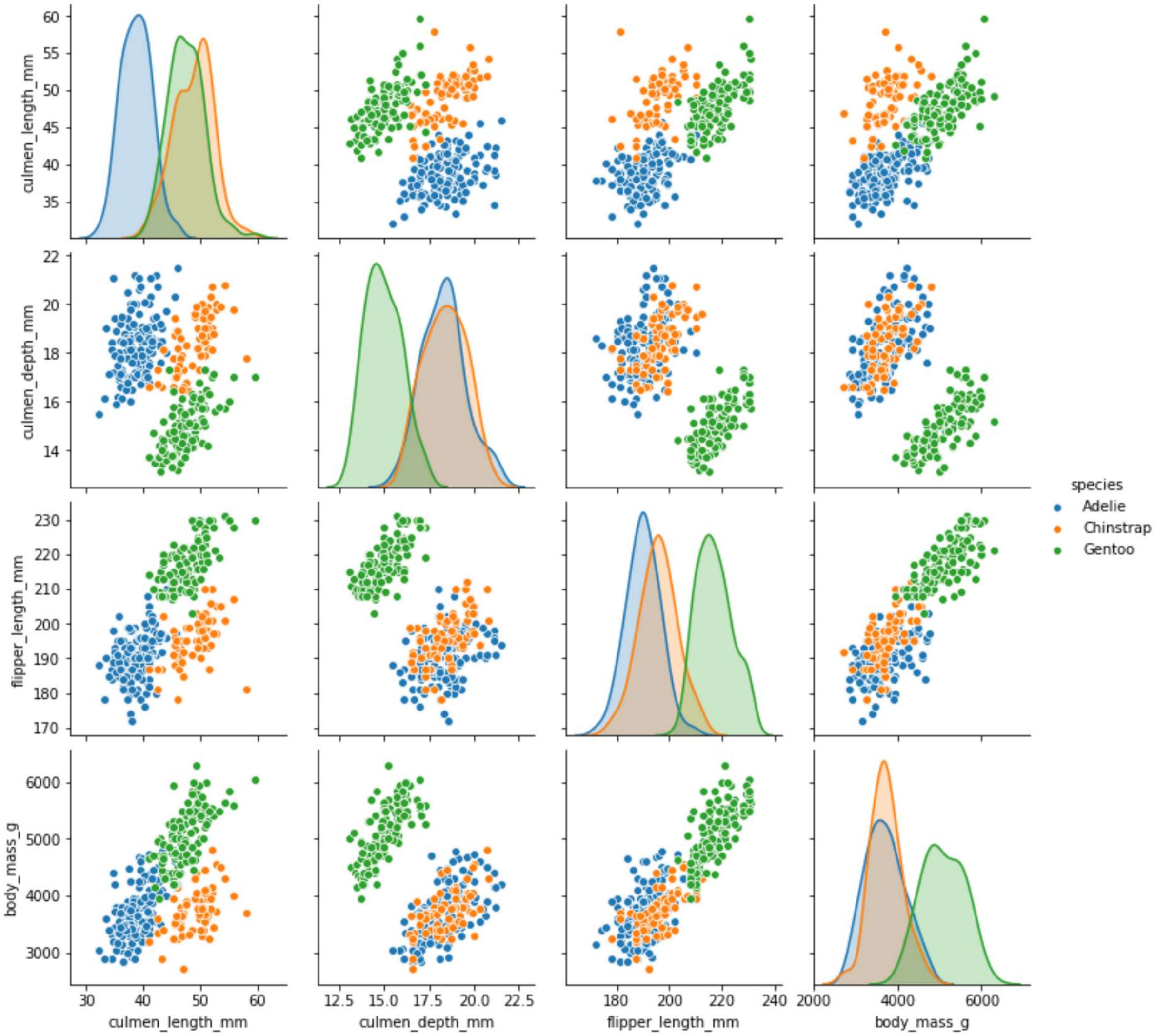
```
In [17]: df["island"].unique()
```

```
Out[17]: array(['Torgersen', 'Biscoe', 'Dream'], dtype=object)
```

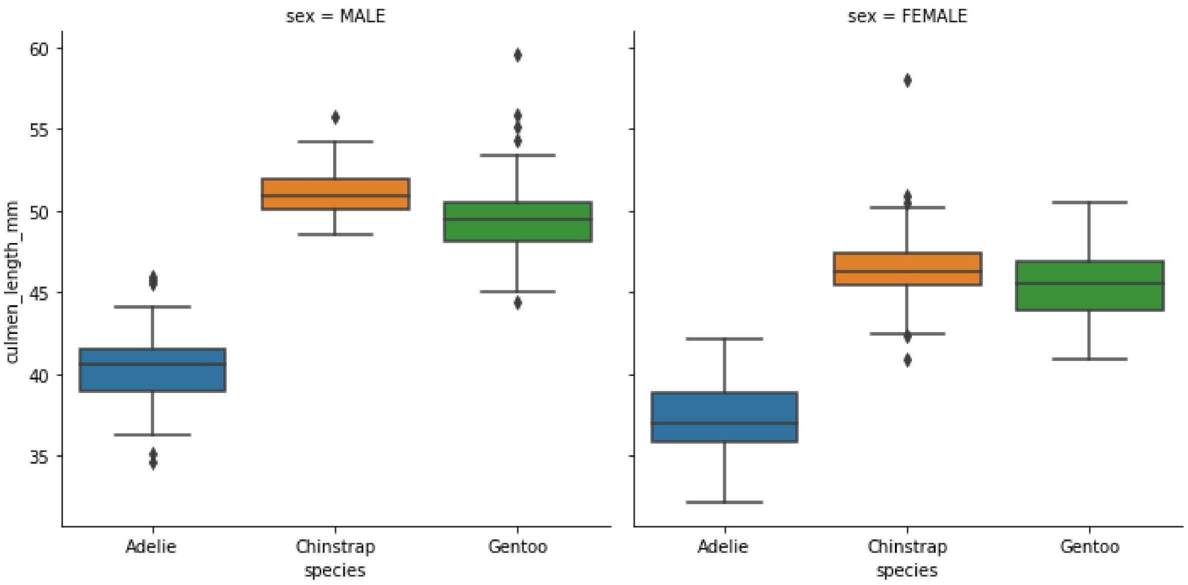
In [18]:
```
sns.scatterplot(x="culmen_length_mm",y="culmen_depth_mm",data = df, hue= "spec
ies")
plt.show()
```



In [19]:
```
sns.pairplot(data=df,hue="species")
plt.show()
```



In [20]:
```
sns.catplot(data=df,x="species",y="culmen_length_mm",kind="box",col = "sex")
plt.show()
```



In [21]:
```
pd.get_dummies(df.drop('species',axis=1),drop_first=True)
```

Out[21]:

	culmen_length_mm	culmen_depth_mm	flipper_length_mm	body_mass_g	island_Dream	isl
0	39.1	18.7	181.0	3750.0	0	
1	39.5	17.4	186.0	3800.0	0	
2	40.3	18.0	195.0	3250.0	0	
4	36.7	19.3	193.0	3450.0	0	
5	39.3	20.6	190.0	3650.0	0	
...	...	...	...	...	...	
338	47.2	13.7	214.0	4925.0	0	
340	46.8	14.3	215.0	4850.0	0	
341	50.4	15.7	222.0	5750.0	0	
342	45.2	14.8	212.0	5200.0	0	
343	49.9	16.1	213.0	5400.0	0	

333 rows × 7 columns

In [22]:
```
X = pd.get_dummies(df.drop("species",axis=1),drop_first=True)
y = df["species"]
```

In [23]:
```
X
```

Out[23]:

	culmen_length_mm	culmen_depth_mm	flipper_length_mm	body_mass_g	island_Dream	isl
0	39.1	18.7	181.0	3750.0	0	
1	39.5	17.4	186.0	3800.0	0	
2	40.3	18.0	195.0	3250.0	0	
4	36.7	19.3	193.0	3450.0	0	
5	39.3	20.6	190.0	3650.0	0	
...	...	...	...	...	...	
338	47.2	13.7	214.0	4925.0	0	
340	46.8	14.3	215.0	4850.0	0	
341	50.4	15.7	222.0	5750.0	0	
342	45.2	14.8	212.0	5200.0	0	
343	49.9	16.1	213.0	5400.0	0	

333 rows × 7 columns

In [24]:
```
y
```

Out[24]:
```
0      Adelie
1      Adelie
2      Adelie
4      Adelie
5      Adelie
        ...  
338    Gentoo
340    Gentoo
341    Gentoo
342    Gentoo
343    Gentoo
Name: species, Length: 333, dtype: object
```

In [25]:
```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=101)
```

In [26]:
```
from sklearn.tree import DecisionTreeClassifier
model = DecisionTreeClassifier()
model.fit(X_train,y_train)
```

Out[26]:
```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=None, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

In [27]:

```
base_pred = model.predict(X_test)
```

In [30]:

```
from sklearn.metrics import confusion_matrix,accuracy_score,classification_rep
ort
print("Accuracy Score:",accuracy_score(y_test,base_pred))
```

```
Accuracy Score: 0.9552238805970149
```

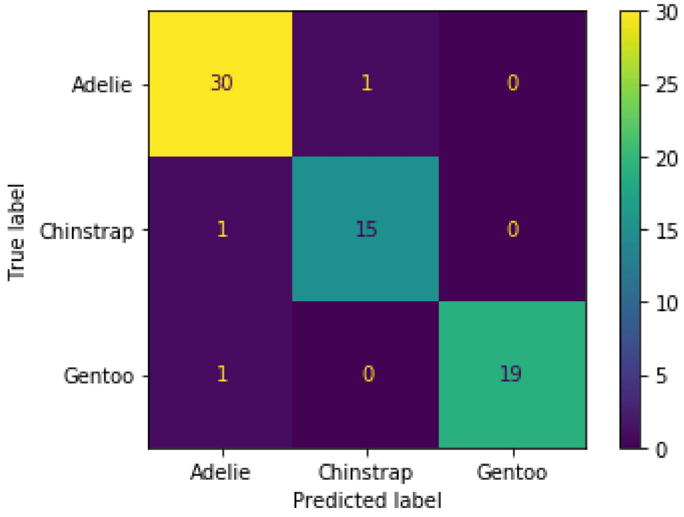
In [32]:

```
print("Confusion Matrix\n",confusion_matrix(y_test,base_pred))
```

```
Confusion Matrix
 [[30  1  0]
 [ 1 15  0]
 [ 1  0 19]]
```

In [35]:

```
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(model,X_test,y_test)
plt.show()
```



In [37]:

```
print(classification_report(y_test,base_pred))
```

```
              precision    recall  f1-score   support

      Adelie       0.94      0.97      0.95        31
   Chinstrap       0.94      0.94      0.94        16
      Gentoo       1.00      0.95      0.97        20

    accuracy                           0.96        67
   macro avg       0.96      0.95      0.95        67
weighted avg       0.96      0.96      0.96        67
```

In [40]:

```
model.feature_importances_
```

Out[40]:

```
array([0.35128085, 0.07088022, 0.54456291, 0.        , 0.03327601,
       0.        , 0.        ])
```

In [41]:

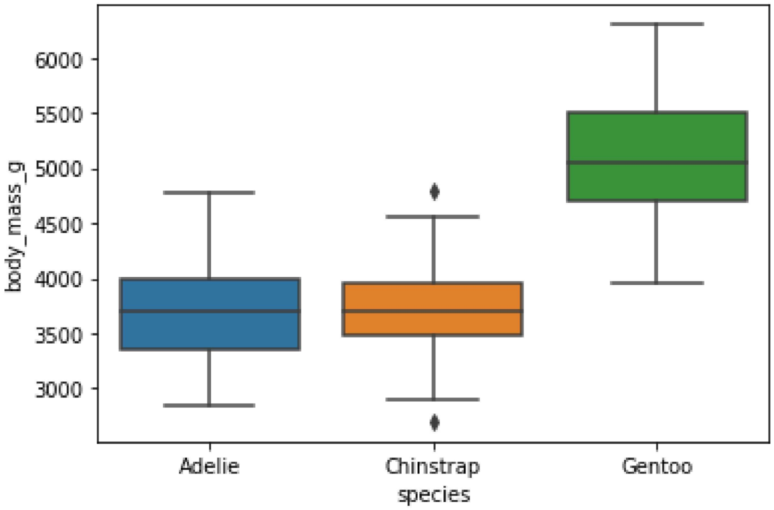
```
pd.DataFrame(index= X.columns, data=model.feature_importances_,columns=["Featu
re Importaces"])
```

Out[41]:

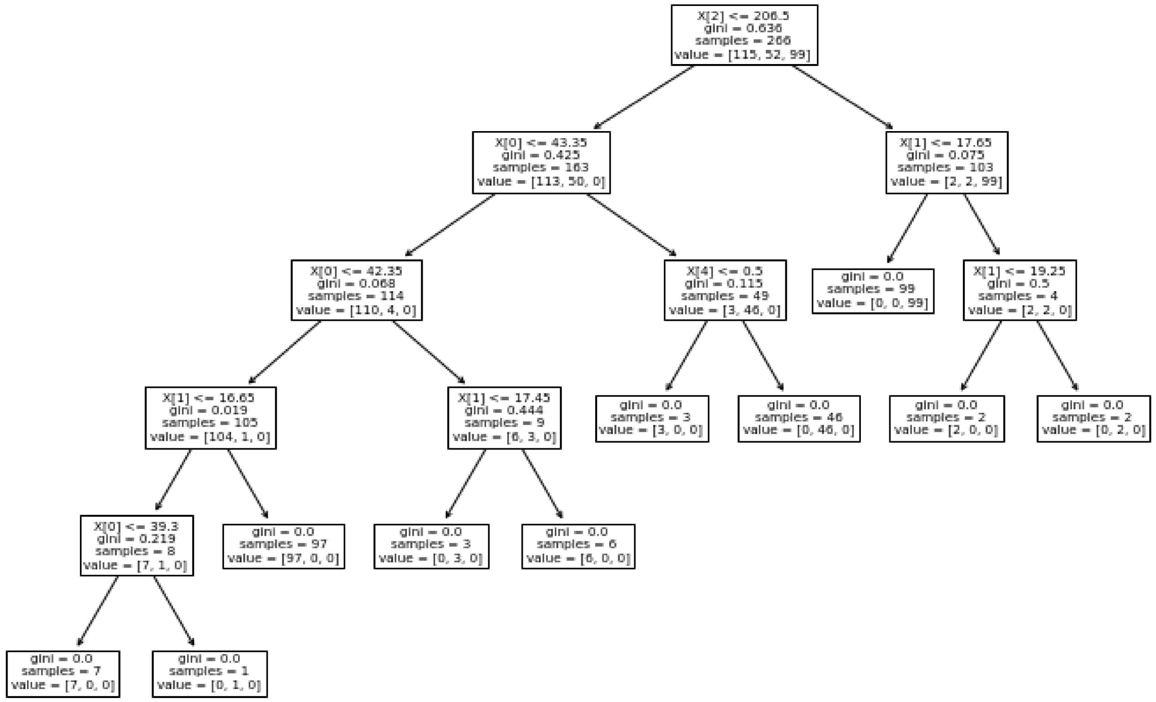
	Feature Importaces
culmen_length_mm	0.351281
culmen_depth_mm	0.070880
flipper_length_mm	0.544563
body_mass_g	0.000000
island_Dream	0.033276
island_Torgersen	0.000000
sex_MALE	0.000000

In [43]:

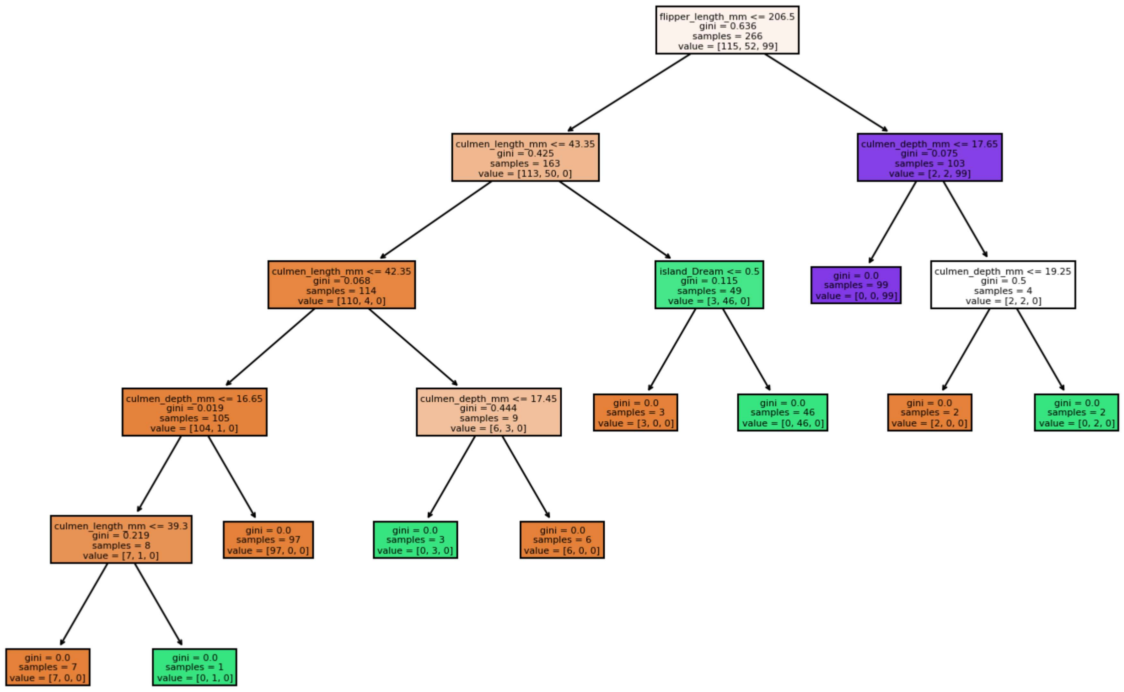
```
sns.boxplot(x="species",y='body_mass_g',data=df)
plt.show()
```



In [46]:
```
from sklearn.tree import plot_tree
plt.figure(figsize=(12,8))
plot_tree(model)
plt.show()
```



In [48]:
```
plt.figure(figsize=(12,8),dpi=150)
plot_tree(model,filled=True,feature_names=X.columns)
plt.show()
```



In [51]:

```
def report_model(model):
    model_preds = model.predict(X_test)
    print(classification_report(y_test,model_preds))
    print('\n')
    plt.figure(figsize=(12,8),dpi=150)
    plot_tree(model,filled=True,feature_names = X.columns)
```

In [52]:

```
#Understanding Hyperparameters in DT
```

In [57]:

```
pruned_tree = DecisionTreeClassifier(max_depth=2)
pruned_tree.fit(X_train,y_train)
```

Out[57]:

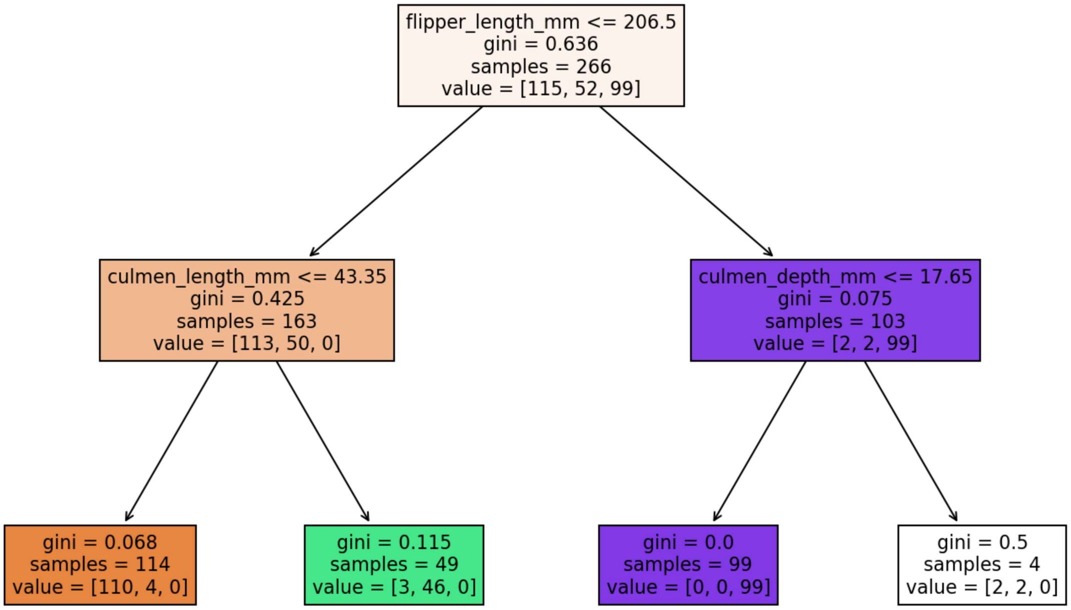
```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=2, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

In [58]:
```
report_model(pruned_tree)
```

```
              precision    recall  f1-score   support

      Adelie       0.88      0.97      0.92        31
   Chinstrap       0.86      0.75      0.80        16
      Gentoo       1.00      0.95      0.97        20

    accuracy                           0.91        67
   macro avg       0.91      0.89      0.90        67
weighted avg       0.91      0.91      0.91        67
```



In [59]:
```
pruned_tree = DecisionTreeClassifier(max_leaf_nodes=3)
pruned_tree.fit(X_train,y_train)
```

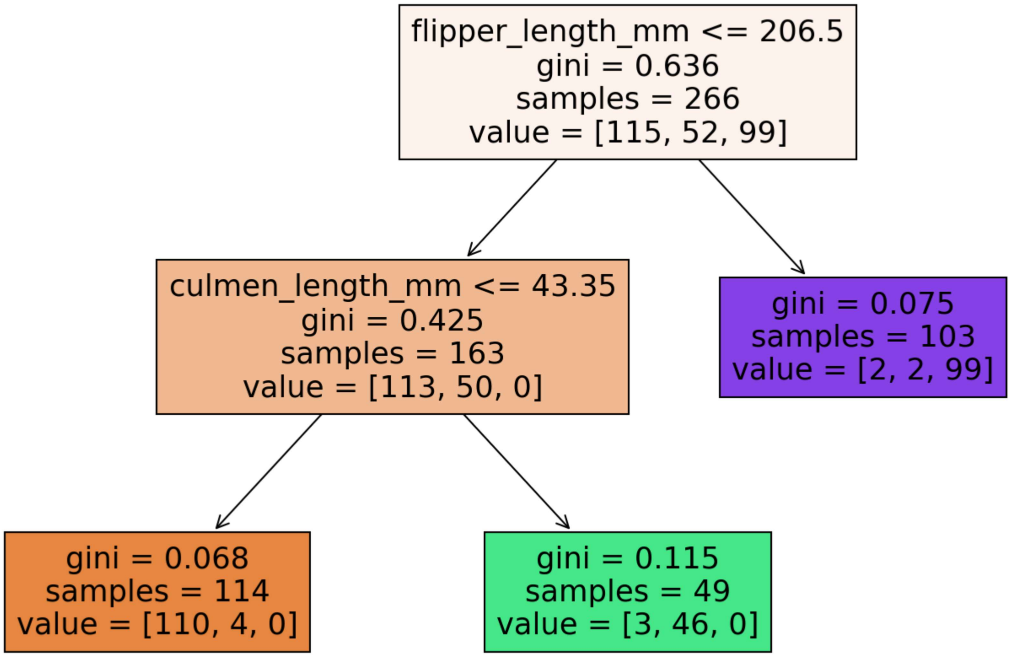
Out[59]:
```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=None, max_features=None, max_leaf_nodes=3,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

In [60]:
```
report_model(pruned_tree)
```

```
              precision    recall  f1-score   support

      Adelie       0.97      0.97      0.97        31
   Chinstrap       0.86      0.75      0.80        16
      Gentoo       0.86      0.95      0.90        20

    accuracy                           0.91        67
   macro avg       0.90      0.89      0.89        67
weighted avg       0.91      0.91      0.91        67
```



In [62]:
```
entropy_tree = DecisionTreeClassifier(criterion = "entropy")
entropy_tree.fit(X_train,y_train)
```

Out[62]:
```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='entropy',
                       max_depth=None, max_features=None, max_leaf_nodes=Non
e,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

```
In [63]: DecisionTreeClassifier(criterion = "entropy")
```

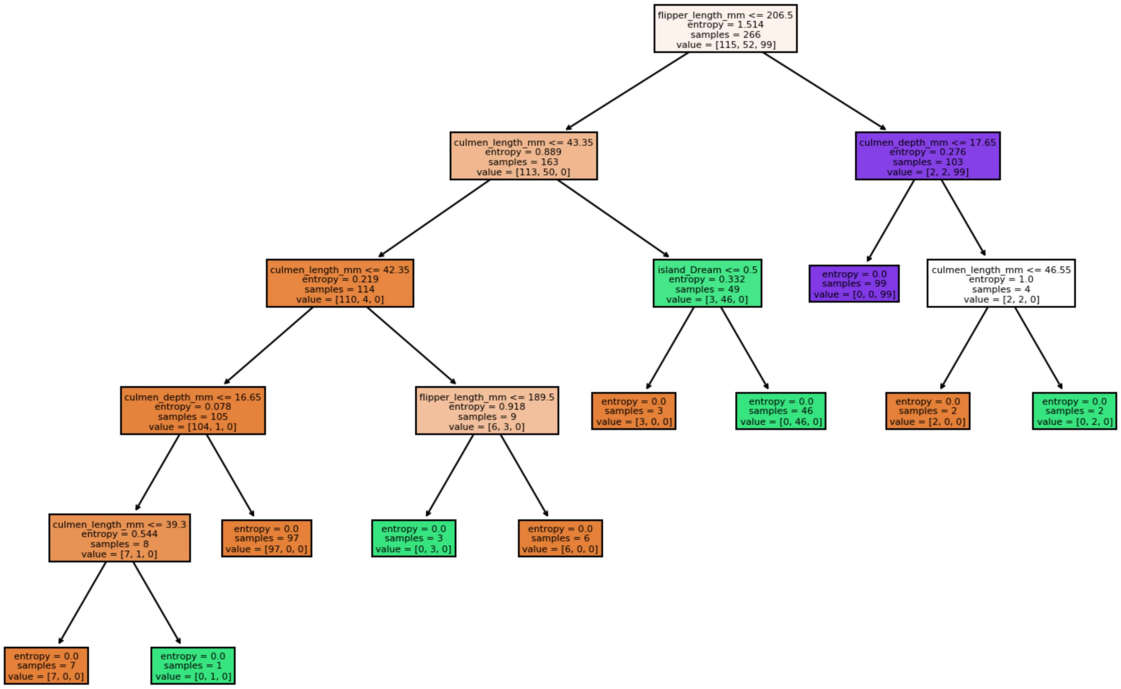
```
Out[63]: DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='entropy',
                                max_depth=None, max_features=None, max_leaf_nodes=Non
         e,
                                min_impurity_decrease=0.0, min_impurity_split=None,
                                min_samples_leaf=1, min_samples_split=2,
                                min_weight_fraction_leaf=0.0, presort='deprecated',
                                random_state=None, splitter='best')
```

```
In [65]: report_model(entropy_tree)
```

```
              precision    recall  f1-score   support

      Adelie       0.97      0.97      0.97        31
   Chinstrap       0.94      1.00      0.97        16
      Gentoo       1.00      0.95      0.97        20

    accuracy                           0.97        67
   macro avg       0.97      0.97      0.97        67
weighted avg       0.97      0.97      0.97        67
```



```
In [ ]:
```