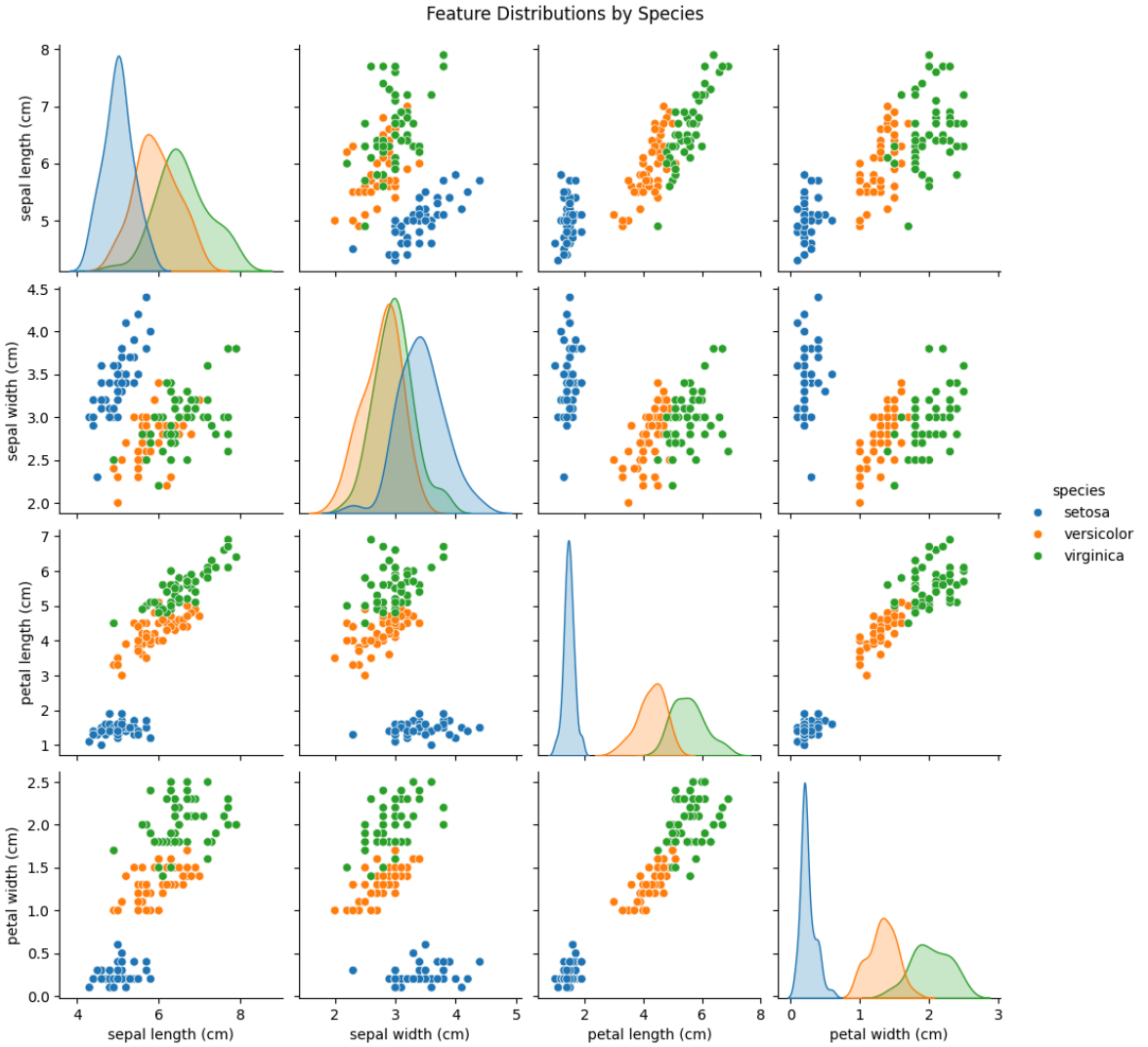
In [1]:
```
# Import required libraries
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.datasets import load_iris
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, classification_report, confusion_mat
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
```

In [2]:
```
iris = load_iris()
df = pd.DataFrame(data=iris.data, columns=iris.feature_names)
df['species'] = iris.target
df['species'] = df['species'].apply(lambda x: iris.target_names[x])

print("First 5 rows of the dataset:")
print(df.head())
```

```
First 5 rows of the dataset:
   sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  \
0                5.1               3.5                1.4               0.2
1                4.9               3.0                1.4               0.2
2                4.7               3.2                1.3               0.2
3                4.6               3.1                1.5               0.2
4                5.0               3.6                1.4               0.2

  species
0  setosa
1  setosa
2  setosa
3  setosa
4  setosa
```

In [3]:
```
# Plot feature distributions
sns.pairplot(df, hue='species')
plt.suptitle('Feature Distributions by Species', y=1.02)
plt.show()
```

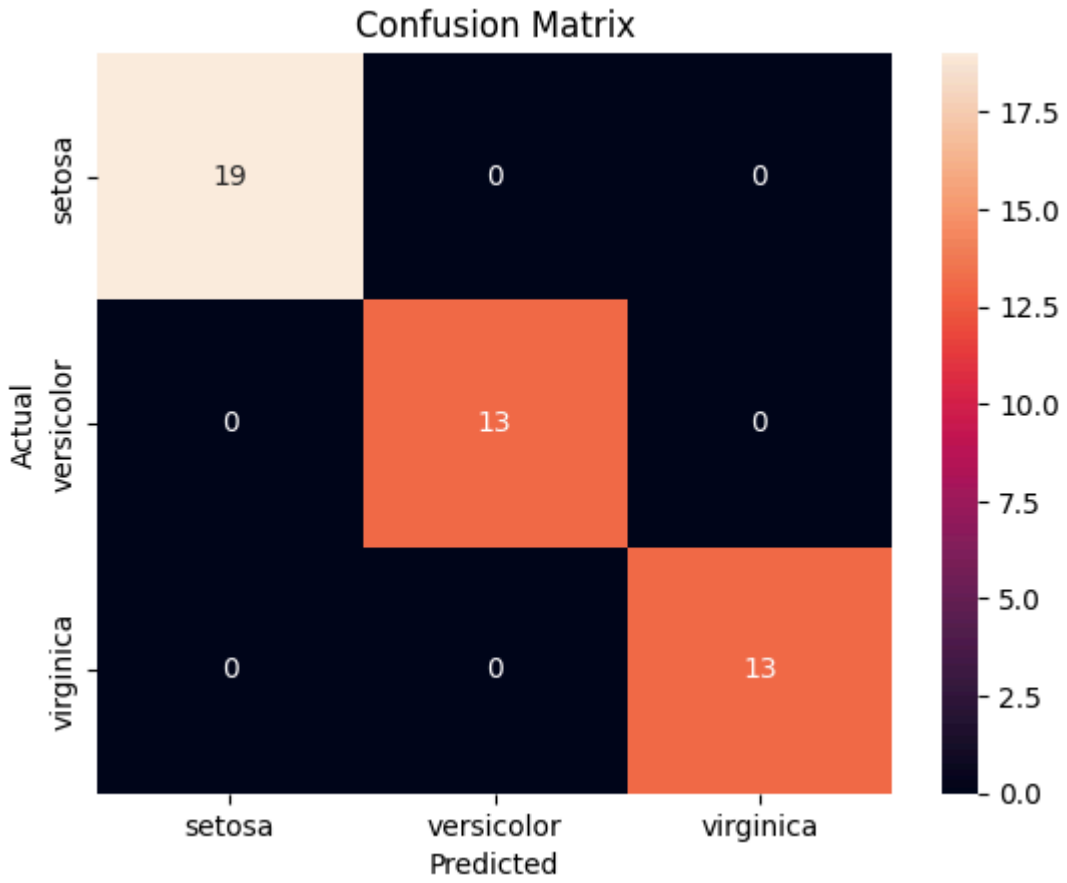


In [4]:
```
# 2. Train a Machine Learning Classifier
X = df[iris.feature_names]
y = df['species']

# Standardize the features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Split into train/test
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.3,
```

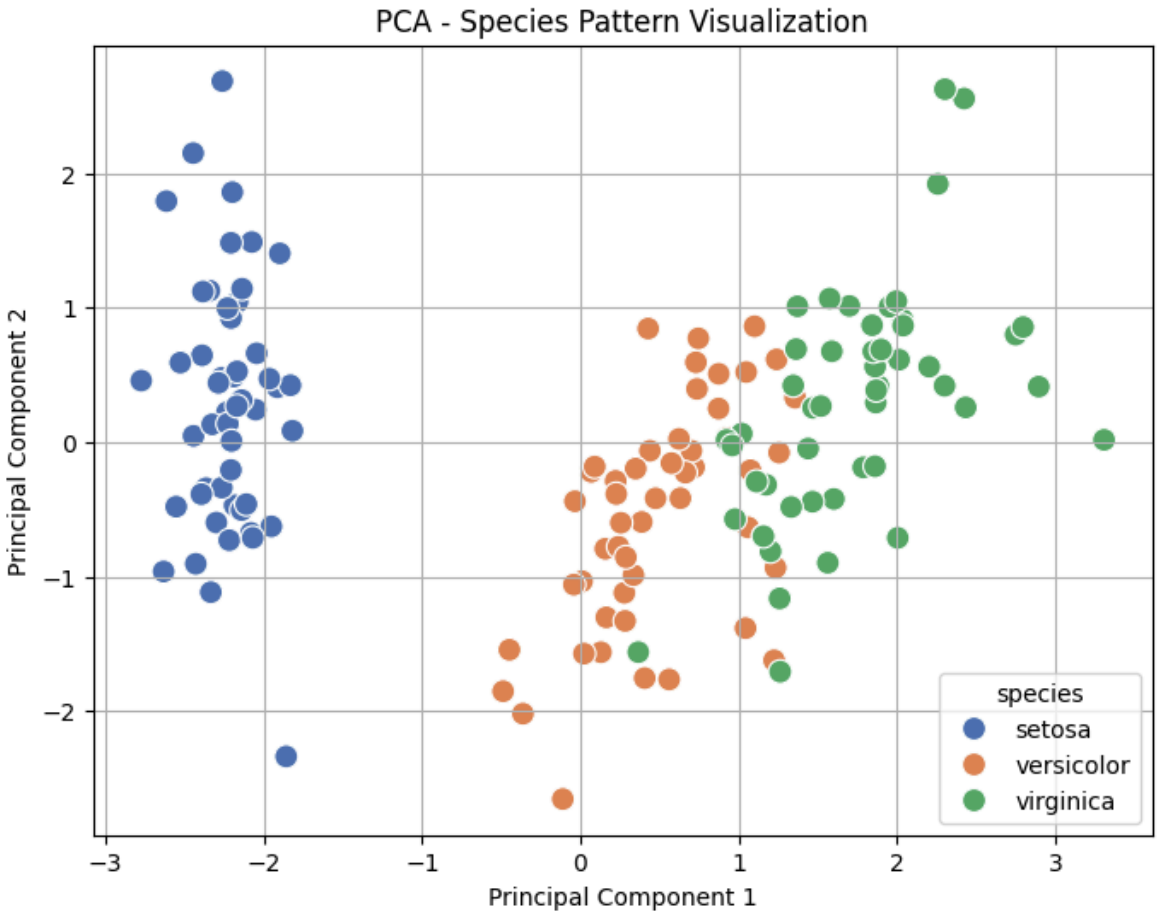
In [5]:
```
# Train Random Forest Classifier
clf = RandomForestClassifier(n_estimators=100, random_state=42)
clf.fit(X_train, y_train)
y_pred = clf.predict(X_test)
```

In [6]:
```
# 3. Evaluate the classifier
print("Accuracy Score:", accuracy_score(y_test, y_pred))
print("\nClassification Report:")
print(classification_report(y_test, y_pred))
print("\nConfusion Matrix:")
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='d', xticklabels=i
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix")
plt.show()
```

```
Accuracy Score: 1.0

Classification Report:
              precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        19
  versicolor       1.00      1.00      1.00        13
   virginica       1.00      1.00      1.00        13

    accuracy                           1.00        45
   macro avg       1.00      1.00      1.00        45
weighted avg       1.00      1.00      1.00        45


Confusion Matrix:
```



In [7]:
```python
# 4. Dimensionality Reduction and Visualization using PCA only
pca = PCA(n_components=2)
X_pca = pca.fit_transform(X_scaled)
plt.figure(figsize=(8,6))
sns.scatterplot(x=X_pca[:,0], y=X_pca[:,1], hue=y, palette="deep", s=100)
plt.title("PCA - Species Pattern Visualization")
plt.xlabel("Principal Component 1")
plt.ylabel("Principal Component 2")
plt.grid(True)
plt.show()
```


PCA - Species Pattern Visualization
Principal Component 2
Principal Component 1
2
1
0
−1
−2
−3
−2
−1
0
1
2
3
species
setosa
versicolor
virginica

In [ ]: