

- Hyperparameter Tuning:

```
```python
from sklearn.model_selection import GridSearchCV

def tune_svm(X, y):
 param_grid = {'C': [0.1, 1, 10], 'gamma': ['scale', 'auto'], 'kernel': ['rbf', 'poly', 'sigmoid']}
 grid_search = GridSearchCV(SVC(), param_grid, refit=True, verbose=3)
 grid_search.fit(X, y)
 return grid_search.best_estimator_
```
```

3. Prediction and Evaluation:

- Prediction:

```
```python
def predict_bird_species(model, X_new):
 prediction = model.predict(X_new)
 return prediction
```
```

- Evaluation:

```
```python
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score

def evaluate_model(model, X_test, y_test):
 y_pred = model.predict(X_test)
 accuracy = accuracy_score(y_test, y_pred)
 precision = precision_score(y_test, y_pred, average='weighted')
 recall = recall_score(y_test, y_pred, average='weighted')
 f1 = f1_score(y_test, y_pred, average='weighted')
 return accuracy, precision, recall, f1
```
```

These algorithms and modules collectively contribute to the effective recognition of bird sounds, ensuring high accuracy and reliability in the predictions. By leveraging advanced audio processing and machine learning techniques, the system provides a robust solution for bird species identification based on their sounds.