

The demography and ecology of the European shag



An integrated research program was initiated to evaluate if the European shag *Phalacrocorax aristotelis* can be used as a robust indicator of the marine environment in Mor Braz, Brittany, France. This program focuses on aspects of the ecology of the shag including its abundance, demography, diet and at-sea distribution measured at three breeding colonies. The annual population growth rate was estimated at 1.01 for the period 1987–2009. The number of breeding pairs (mean: 565) was highly variable from year to year. Part of this interannual variation was explained by variations in sea surface temperature and sea surface height in winter and spring: the number of breeding pairs was negatively related to sea surface temperature and sea surface height. First year, second year and adult survival probabilities were 0.44, 0.76 and 0.81, respectively. Juvenile survival rate varied between colonies, despite the short distances separating these islets. Average productivity was one young fledged per nest, but it varied between years and islets. Density of individuals at sea varied between 1.40 ind.km⁻² during the breeding season and 3.08 ind.km⁻² after the breeding season had ended. Individuals foraged up to 7 km from the nest and performed on average 2.7 foraging trips per day. The average number of dives deeper than 5 m varied from 126 to 400 per day. Mean diving depth, dive duration and time spent at bottom were 13 m, 28 s, and 19 s respectively. Regurgitated pellets were collected regularly. Four fish families (Gadidae, Gobiidae, Atherinidae and Labridae) represented more than 65% of the preys throughout the year, a percentage reaching more than 95% of the prey from May to October. The other fish in the diet were Cottidae, Ammodytidae, and Clupeidae. The diet of the European shag consisted of benthic fish throughout the year, and also included pelagic fish more frequently between June and October. The synchronous variations of productivity between colonies suggest that some common environmental factors affect this demographic parameter at the regional scale. Thus, the European shag has a good potential for being a reliable ecological indicator of the state of this marine environment. Finally, improved knowledge on the foraging ecology of shags will be useful in the process of designing Marine Protected Areas in the Mor Braz to help ensure sustainable management of marine resources and biodiversity conservation.

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