

## IMPROVED MALLARD SURVIVAL IN NORTHERN EUROPE OVER THE PAST FORTY YEARS

Gunnar Gunnarsson<sup>1</sup>, Jonas Waldenström<sup>2</sup>, and Thord Fransson<sup>3</sup>

1. Aquatic Biology and Chemistry Group, Kristianstad University, 29188 Kristianstad, Sweden, [gunnar.gunnarsson@hkr.se](mailto:gunnar.gunnarsson@hkr.se)

2. Section for Zoonotic Ecology and Epidemiology, School of Natural Sciences, Linnaeus University, 39182 Kalmar, Sweden.

3. Bird Ringing Centre, Department of Vertebrate Zoology, Swedish Museum of Natural History, 10405 Stockholm, Sweden.

Vital rates are the cornerstones affecting population dynamics, and are necessary to estimate in order to judge population viability. Knowledge about vital rates and their changes over time is especially important for hunted species, for example to be able to determine sustainable harvest levels. We estimated annual age and sex specific survival rates of the most common waterfowl game in Europe, i.e. the Mallard (*Anas platyrhynchos*), and studied possible links between survival and hunting pressure, weather (winter harshness) and migration behaviour. Ringing data, covering more than forty years (1964-1982 [called 'yearly period'] and 2002-2008 [called 'late period']), were collected in one stationary duck trap located at Ottenby, south-east Sweden, and mark-recovery data were analysed with a theoretic-information approach using program MARK. In total 10,490 Mallards were marked, i.e. 6,409 in the early period and 4,081 in the late, of which 13.3% (early period) and 4.7% (late period) were recovered dead (mostly hunting; >92%). Within each time period, the survival of Mallards was not dependent on age, sex and year. However, when the different time periods were compared, annual survival was lower in the early period (0.58–0.63) compared to the late (0.69–0.71). There are several possible explanations why survival has improved. Although winter harshness did not directly correlate to survival in the modelling analyses, relationships may be more intricate than as it first appears. Firstly, data show that Mallards in the late period have better body condition (body mass) than in the early period, which may have several explanations, including climate aspects. Secondly, data suggest that the Mallard has shortened its migratory route when time periods are contrasted, with wintering areas further to the north in the late period. Again milder winters may have contributed to this pattern as migrating distances for female Mallards were correlated with winter harshness data. As a consequence, this could potentially also affect survival since migration is costly. Finally, although it is hard to quantify, hunting pressure may also have played a role since it seems to be lower in the late period compared to the early.