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Ruffs in rough times

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References

A

- Aharon-Rotman, Y., Soloviev, M., Minton, C., Tomkovich, P., Hassell, C., Klaassen, M. 2015. Loss of periodicity in breeding success of waders links to changes in lemming cycles in Arctic ecosystems. *Oikos* 124, 861–870.
- Alerstam, T., 1990. Bird migration. Cambridge University Press, Cambridge
- Alerstam, T., Hedenström, A., Åkesson, S. 2003. Long-distance migration: evolution and determinants. *Oikos* 2, 247–260.
- Alerstam, T., Lindström, Å. 1990. Optimal bird migration: the relative importance of time, energy and safety. Bird migration: physiology and ecophysiology. (ed E. Gwinner), pp. 331–351. Springer-Verlag, Berlin, Germany.
- Alves, J.A., Gunnarsson, T.G., Potts, P.M., Gélinaud, G., Sutherland, W.J. and Gill, J.A. 2012. Overtaking on migration: does longer distance migration always incur a penalty? *Oikos* 121, 464–470.
- Anthony, L.L., Blumstein, D.T. 2000. Integrating behaviour into wildlife conservation: the multiple ways that behaviour can reduce N_e . *Biol Conserv* 95, 303–315.
- Arnason, A.N., Mills, K.H. 1981. Bias and loss of precision due to tag loss in Jolly–Seber estimates for mark–recapture experiments. *Can J Fish Aquat Sci* 38, 1077–1095.
- Ausden, M., Bolton, M. 2012. Breeding waders on wet grasslands: factors influencing habitat suitability. (ed R.J. Fuller) *Birds and Habitat: Relationships in Changing Landscapes*, pp. 278–306. Cambridge University Press, Cambridge.

B

- Bacetti, N. Chelazzi, L., Colombini, I., Serra, L. 1998. Preliminary data on the diet of migrating Ruffs *Philomachus pugnax* in northern Italy. *Int Wader Stud* 10, 361–364.
- Baker, A.J., Gonzalez, P.M., Piersma, T., Niles, L.J., de Lima, S., do Nascimento, I., Atkinson, P.W., Collins, P., Clark, N.A., Minton, C.D.T., Peck, M.K., Aarts, G. 2004. Rapid population decline in red knots: fitness consequences of decreased refuelling rates and late arrival in Delaware Bay. *Proc R Soc B* 271, 875–882.
- Baldwin, F.M. 1917. Diurnal activity of the earthworm. *J Anim Behav* 7, 187–190.
- Ballmann, P. 2004. Fossil Calidrinae (Aves: Charadriiformes) from the Middle Miocene of the Nördlinger Ries. *Bonn Zool Beitr* 52, 101–114.
- Barbosa, A. 1995. Foraging strategies and their influence on scanning and flocking behaviour of waders. *J Avian Biol* 26, 182–186.
- Barbosa, P., Castellanos, I. 2005. Ecology of Predator-Prey Interactions. Oxford University Press, Oxford.
- Bartón, K. 2009. MuMIn: multi-model inference. R package, version 1.13.4. Available at <http://r-forge.r-project.org/projects/mumin/>
- Bauer, S. Hoye, B.J. 2014. Migratory animals couple biodiversity and ecosystem functioning worldwide. *Science* 344, 1242552.
- Bearhop, S., Waldron, S., Votier, S.C., Furness, R.W. 2002. Factors that influence assimilation rates and fractionation of nitrogen and carbon stable isotopes in avian blood and feathers. *Physiol Biochem Zool* 75, 451–458.
- Beintema, A.J. 1986. Man-made polders in the Netherlands: a traditional habitat for shorebirds. *Colonial Waterbirds* 9, 196–202.
- Beintema, A.J., Moedt, O., Ellinger, D. 1995. Ecologische Atlas van de Nederlandse Weidevogels. Schuyt & Co, Haarlem.
- Bengtson, S.A., Rundgren, S., Nilsson, A., Nordström, S. 1978. Selective predation on Lumbricids by Golden Plover *Pluvialis apricaria*. *Oikos* 31, 164–168.

- Berger, J. 2004. The last mile: how to sustain long distance migration in mammals. *Cons Biol* 18, 320–331.
- BirdLife International, 2004. Birds in Europe: population estimates, trends and conservation status. BirdLife International (Conservation Series No.12), Cambridge.
- Blomqvist, S. Holmgren, N., Åkesson, S., Hedenström, A., Pettersson, J. 2002. Indirect effects of lemming cycles on sandpiper dynamics: 50 years of counts from southern Sweden. *Oecologia* 133, 146–158.
- Boele, A., van Bruggen, J., Hustings, F., Koffijberg, K., Vergeer, J.W., van der Meij, T. 2016. Broedvogels in Nederland in 2014. Sovon-rapport 2016, 04.
- Bos, J.F.F.P., Smit, A.B.L., Schröder, J.J. 2013. Is agricultural intensification in the Netherlands running up to its limits? *NJAS – Wagen. J Life Sci* 66, 65–73.
- Both, C., Visser, M.E. 2005. The effect of climate change on the correlation between avian life-history traits. *Glob Change Biol* 11, 1606–1613.
- Bowen, G.J., Wassenaar, L.I., Hobson, K.A. 2005. Global application of stable hydrogen and oxygen isotopes to wildlife forensics. *Oecologia* 143, 337–348.
- Bradford, A., Wade, P., Weller, D., Burdin, A., Ivashchenko, Y., Tsidulko, G., VanBlaricom, G.R., Brownell, R.L.Jr. 2006. Survival estimates of western gray whales *Eschrichtius robustus* incorporating individual heterogeneity and temporary emigration. *Mar Ecol Prog Ser* 315, 293–307.
- Brommer, J.E., Lehikoinen, A., Valkama, J. 2012. The breeding range of central European and Arctic bird species move poleward. *PloS ONE* 7, e43648.
- Buehler, D.M., Piersma, T. 2008. Travelling on a budget: predictions and ecological evidence for bottlenecks in the annual cycle of long-distance migrants. *Phil Trans R Soc B-Biol Sci*, 363, 247–266.
- Burnham, K.P., Anderson, D.R. 2002. Model selection and multimodel inference: a practical information-theoretic approach, 2nd edn. Springer, New York.
- Burton, N.H.K., Armitage, M.J.S. 2005. Differences in the diurnal and nocturnal use of intertidal feeding grounds by Redshank *Tringa totanus*. *Bird Study* 52, 120–128.
- Burton, P.J.K. 1974. Feeding and the feeding apparatus in waders. British Museum (Natural History), London.
- Butt, K.R., Nuutinen, V., Siren, T. 2003. Resource distribution and surface activity of adult *Lumbricus terrestris* L. in an experimental system. *Pedobiologia* 47, 548–553.
- C**
- Carroll, M.J., Dennis, P., Pearce-Higgins, J., Thomas, C.D. 2011. Maintaining northern peatland ecosystems in a changing climate: Effects of soil moisture, drainage and drain blocking on craneflies. *Global Change Biol* 17, 2991–3001.
- Castelijns, H. 1994. Black-tailed godwit *Limosa limosa islandica* and ruff *Philomachus pugnax* winter in increasing numbers in Zeeuws-Vlaanderen (SW-Netherlands). *Limosa* 67, 113–111.
- Caswell, H. 2001. Matrix population models: construction, analysis and interpretation, 2nd edn. Sinauer Associates, Sunderland, Massachusetts.
- Catry, T., Lourenço, P.M., Lopes, R.J., Bocher, P., Carneiro, C., Alves, J.P., Delaporte, P., Bearhop, S., Piersma, T., Granadeiro, J.P. 2016. Use of stable isotope fingerprints to assign wintering origin and trace shorebird movements along the East-Atlantic flyway. *Basic Appl Ecol* 17, 177–187.
- Caut, S., Angula, E., Courchamp, F. 2009. Variation in discrimination factors ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$): the effect of diet isotopic values and application for diet reconstruction. *J Appl Ecol* 46, 443–453.

- Chamberlain, D.E., Hatchwell, B.J., Perrins, C.M. 1999. Importance of feeding ecology to the reproductive success of Blackbirds *Turdus merula* nesting in rural habitats. *Ibis* 141, 415–427.
- Chan, Y.C., Brugge, M., Tibbitts, T.L., Dekinga, A., Porter, R., Klaassen, R.H.G., Piersma, T. 2016. Testing an attachment method for solar-powered tracking devices on a long-distance migrating shorebird. *J Ornitho* 157, 277–287.
- Charmentier, A., Gienapp, P. 2014. Climate change and timing of avian breeding and migration: evolutionary versus plastic changes. *Evol Appl* 7, 15–28.
- Choquet, R., Béchet A., Guédon Y. 2014. Applications of hidden hybrid Markov/semi-Markov models: from stopover duration to breeding success dynamics. *Ecol Evol* 4, 817–826.
- Choquet, R., Lebreton, J.D., Gimenez, O., Reboulet, A.M., Pradel, R. 2009a. U-CARE: Utilities for performing goodness of fit tests and manipulating CAPture-REcapture data. *Ecography* 32, 1071–1074.
- Choquet, R., Nogué, E. 2011. E-surge 1-8 user's manual. CEFE, Montpellier, France.
- Choquet, R., Rouan, L., Pradel, R. 2009b. Program E-SURGE: A software application for fitting multievent models. In: Thomson D L, Cooch E G, Conroy M J (eds.) *Modeling demographic processes in marked populations*. Springer US, New York, pp. 845–865.
- Christianen, M.J.A., Middelburg, J.J., Holthuisjen, S.J., Jouta, J., Compton, T.J., van der Heide, T., Piersma, T., Sinninghe Damsté, J.S., van der Veer, H.W., Schouten, S., Olf, H. 2017. Benthic primary producers are key to sustain the Wadden Sea food web: a stable carbon isotope analysis at landscape scale. *Ecology* 98, 1498–1512
- Conklin, J.R., Verkuil, Y.I., Smith, B.R. 2014. Prioritizing Migratory Shorebirds for Conservation Action on the East Asian-Australasian Flyway. WWF Hong Kong.
- Cormack, R.M. 1964. Estimates of survival from the sighting of marked animals. *Biometrika* 51, 429–438.
- Coulton, D.W., Clark, R.G., Hebert, C.E. 2010. Determining natal origins of birds using stable isotopes ($\delta^{34}\text{S}$, $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$): Model validation and spatial resolution for mid-continent Mallards. *Waterbirds* 33, 10–21.
- Courchamp, F., Berec, L., Gascoigne, J. 2008. *Allee Effects in ecology and conservation*. Oxford University Press, New York.
- Cramp, S., Simmons, K.E.L. (eds.) 1983. *The birds of the Western Palearctic*. Vol. III. Oxford University Press, Oxford.
- Crespin, L., Choquet, R., Lima, M., Merritt, J., Pradel, R. 2008. Is heterogeneity of catchability in capture–recapture studies a mere sampling artifact or a biologically relevant feature of the population? *Popul Ecol* 50, 247–256.
- Cunningham, S.J., Alley, M.R., Castro, I., Potter, M.A., Cunningham, M., Pyne, M.J. 2010. Bill morphology of ibises suggests a remote-tactile sensory system for prey detection. *Auk* 127, 308–316.
- D**
- Darwin, C. 1881. *The formation of vegetable mould through the action of worms with observations on their habits*. John Murray, London.
- Davidson, N. 2014. How much wetland has the world lost? Long-term and recent trends in global wetland area. *Mar Freshwater Res* 65, 934–941.
- Devereux, C.L., McKeever, C.U., Benton, T.G., Whittingham, M.J. 2004. The effect of sward height and drainage on Common Starlings *Sturnus vulgaris* and Northern Lapwings *Vanellus vanellus* foraging in grassland habitats. *Ibis* 146, 115–122.
- Devos, K., T'Jollyn, F., Brosens, D., Desmet P. 2012. *Watervogels - Wintering waterbirds in Flanders, Belgium*. v3.3. Research Institute for Nature and Forest (INBO). Dataset/ Occurrence.

- Dias, M.P., Granadeiro, J.P., Lecoq, M., Santos, C.D., Palmeirim, J.M. 2006. Distance to high-tide roosts constrains the use of foraging areas by dunlins: implications for the management of estuarine wetlands. *Biol Cons* 131, 446–452
- Dierschke, V., Mendel, B., Schmaljohann, H. 2004. Differential timing of spring migration in northern wheatears *Oenanthe oenanthe*: hurried males or weak females? *Behav Ecol Sociobiol* 57, 470–480.
- Dietz, M.W., Piersma, T., Dekinga, A., Korthals, H., Klaassen, M. 2013. Unusual patterns in ^{15}N blood values after a diet switch in red knot shorebirds. *Isotopes Environ Health Stud* 49, 283–292.
- Dietz, M.W., Spaans, B., Dekinga, A., Klaassen, M., Korthals, H., van Leeuwen, C., Piersma, T. 2010. Do red knots (*Calidris canutus islandica*) routinely skip Iceland during southward migration? *Condor* 112, 48–55.
- Donald, P.F., Green, R.E., Heath, M.F. 2001. Agricultural intensification and the collapse of Europe's farmland bird populations. *P Roy. Soc. Lon. B Bio* 268, 25–29.
- Donald, P.F., Sanderson, F.J., Burfield, I.J., van Bommel, F.P.J. 2006. Further evidence of continent-wide impacts of agricultural intensification on European farmland birds, 1990–2000. *Agri Ecosyst Environ* 116, 189–196.
- Dray, S., Dufour, A. 2007. The Ade4 package: implementing the duality diagram for ecologists. *Journal of Statistical Software* 22, 1–20.
- Duarte, S.V., Gangoso, L., Bouten, W., Figuerola, J. 2016. Overseas seed dispersal by migratory birds. *Proc R Soc B* 283, 20152406.
- Duckworth, G.D., Altwegg, R., Guo, D. 2010. Soil moisture limits foraging: A possible mechanism for the range dynamics of the Hadeda Ibis in southern Africa. *Divers. Distrib.* 16, 765–772.
- Duijns, S., Jukema, J., Spaans, B., van Horssen, P., Piersma, T. 2012. Revisiting the proposed leap-frog migration of bar-tailed godwits along the East-Atlantic flyway. *Ardea* 100, 37–43.
- Duijns, S., Knot, I.E., Piersma, T., van Gils, J.A. 2015. Field measurements give biased estimates of functional response parameters, but help explain foraging distributions. *J Anim Ecol* 84, 565–575.
- Dusenbery, D.B. 1992. *Sensory ecology: how organisms acquire and respond to information.* Freeman, New York.
- E**
- Edwards, C.A., Bohlen, P.J. 1996. *Biology and Ecology of Earthworms.* 3rd edition, Chapman & Hall, London, UK.
- Evans Ogden, J.L., Hobson, K.A., Lank, D.B. 2004. Blood isotopic ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) turnover and diet-tissue fractionation factors in captive dunlin (*Calidris alpina pacifica*). *Auk* 121, 170–177.
- Ezealor, A.U., Giles, R.H.Jr. 1997. Wintering Ruffs *Philomachus pugnax* are not pests of rice *Oryza* spp. in Nigeria's Sahelian wetlands. *Wildfowl* 48, 202–209.
- F**
- Fearnbach, H., Durban, J., Parsons, K., Claridge, D. 2012. Photographic mark-recapture analysis of local dynamics within an open population of dolphins. *Ecol Appl* 22, 1689–1700.
- Foley, J.A., DeFries, R., Asner, G.P., Barfort, C., Bonan, G., Carpenter, S.R., Chapin, F.S., Coe, M.T., Daily, D.C., Gibbs, H.K., Helkowski, J.H., Holloway, T. Howard, E.A., Kucharik, C.J., Montfedra, C., Patz, J.A., Prentice, C., Ramankutty, N. Snyder, P.K. 2005. Global consequences of land use. *Science* 309, 570–574.

- Franks, S.E., Norris, D.R., Kyser, T.K., Fernández, G., Schwarz, B., Carmona, R., Colwell, M.A., Sandoval, J.C., Dondua, A., River Gates, H., Haase, B., Hodkinson, D.J., Jiménez, A., Lancot, R.B., Ortego, B., Sandercock, B.K., Sanders, F., Takekawa, J.Y., Warnock, N., Ydenberg, R.C., Lank, D.B. 2012. Range-wide patterns of migratory connectivity in the western sandpiper *Calidris mauri*. *J Avian Biol* 43, 155–167.
- Frederiksen, M., Anthony, D.F., Madsen, J., Colhoun, K. 2001. Estimating the total number of birds using a staging site. *J Wild Manage* 65, 282–289.
- G**
- Gascoigne, J., Berec L., Gregory, S., Courchamp, F. 2009. Dangerously few liaisons: a review of mate-finding Allee effects. *Popul Ecol* 51, 355–372.
- Gerard, B.M. 1967. Factors affecting earthworms in pastures. *J Anim Ecol* 36, 235–252.
- Gill, J.A., Clark, J., Clark, N., Sutherland, W.J. 1995. Sex-differences in the migration, moult and wintering areas of British ringed ruff. *Ring Migr* 16, 159–167.
- Gill, R.E.Jr., Tibbitts, T.L., Douglas, D.C., Handel, C.M., Mulcahy, D.M., Gottschalck, J.C., Warnock, N., McCaffery, B.J., Battley, P.F., Piersma, T. 2009. Extreme endurance flights by landbirds crossing the Pacific Ocean: ecological corridor rather than barrier? *Proc R Soc Lond B* 276, 447–457.
- Gilroy, J.J., Gill, J.A., Buchart, S.H.M., Jones, V.R., Franco A.M.A. 2016. Migratory diversity predicts population declines in birds. *Ecol Lett* 19:301–317.
- Gimenez, O., Viallefont, A., Charmantier, A., Pradel, R., Cam, E., Brown, C.R., Anderson, M.D., Bomberger Brown, M., Covas, R., Gaillard, J.-M. 2008. The risk of flawed inference in evolutionary studies when detectability is less than one. *Am Nat* 172, 441–448.
- Girard, O., Scott, D., Dodman, T. 2009. Ruff, *Philomachus pugnax*. In: Delany S, Scott D, Dodman T, Stroud S (eds.) An atlas of wader populations in Africa and western Eurasia. Wetlands International, Wageningen.
- Glutz von Blotzheim, U.N., Bauer, K.M., Bezzel, E. 1975. Handbuch der vögel mitteleuropas: Charadriiformes (1. Teil), Volume 6. Akademische Verlag, Wiesbaden.
- Green, R.E., Hirons, G.J.M., Cresswell, B.H. 1990. Foraging habitats of female Common Snipe *Gallinago gallinago* during the incubation period. *J Appl Ecol* 27, 325–335.
- Grosbois, V., Gimenez, O., Gaillard, J., Pradel, R., Barbraud, C., Clobert, J., Moller, A., Weimerskirch, H. 2008. Assessing the impact of climate variation on survival in vertebrate populations. *Biol Rev* 83, 357–399.
- Groen N.M., Kentie R., de Goeij P, Verheijen B., Hooijmeijer, J.C.E.W., Piersma T. 2012. A modern landscape ecology of Black-tailed Godwits: habitat selection in southwest Friesland, the Netherlands. *Ardea* 100, 19–28.
- Grueber, C.E., Nakagawa, S., Laws, R.J., Jamieson, I.G. 2011. Multitmodal inference in ecology and evolution: challenges and solutions. *J Evol Biol* 24, 699–711.
- Guérin, S, Picard, D., Choquet, R. Besnard, A. 2017. Advances in methods for estimating stopover duration for migratory species using capture-recapture data. *Ecol Appl* 27, 1594–1604.
- Gutiérrez-Esposito, C., Ramírez, F., Afán, I., Forero, M.G., Hobson, K.A. 2015. Toward a deuterium feather isoscape for sub-Saharan Africa: Progress, challenges and the path ahead. *PLoS One* 10, e0135938.

H

- Hallman, C.A., Foppen, R.P.B., Turnhout, C.A.M., de Kroon, H. Jogejans, E. 2014. Declines in insectivorous birds associated with high neonicotinoid concentrations. *Nature* 511, 341–343.

- Hallman, C.A., Sorg, M., Jongejans, E., Siepel, H., Hofland, N., Schwan, H., Stenmans, W., Müller, A., Sumser, H., Hörren, Goulson, D., de Kroon, H. 2017. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PlosOne* 12, e0185809.
- Hamilton, W.J. 1951. The food and feeding behavior of the Garter Snake in New York State. *Am Midl Nat* 46, 385–390.
- Hansen, S., Engelstad, F. 1999. Earthworm populations in a cool and wet district as affected by tractor traffic and fertilisation. *Appl Soil Ecol* 13, 237–250.
- Harrison, X.A., Blount, J.D., Inger, R., Norris, D.R., Bearhop, S. 2011. Carry-over effects as drivers of fitness differences in animals. *J Anim Ecol* 80, 4–18.
- Hebert, C.E., Wassenaar, L.I. 2001. Stable nitrogen isotopes in waterfowl reflect agricultural land use in western Canada. *Envir Sci Technol* 35, 3482–3487.
- Hebert, C.E., Wassenaar L.I. 2005. Feather stable isotopes in western north American waterfowl: spatial patterns, underlying factors, and management applications. *Wildl Soc Bull* 33, 92–102.
- Hestbeck, J.B., Nichols, J.D., Malecki, R.A. 1991. Estimates of movement and site fidelity using mark resight data of wintering Canada Geese. *Ecology* 72, 523–533.
- Hobson, K.A. 1999. Tracing origins and migration of wildlife using stable isotopes: a review. *Oecologia* 120, 314–326.
- Hobson, K.A. 2005. Stable isotopes and the determination of avian migratory connectivity and seasonal interactions. *Auk* 122, 1037–1048.
- Hobson, K.A., Clark, R.G. 1992. Assessing avian diets using stable isotopes I: turnover of ^{13}C in tissues. *Condor* 94, 181–188.
- Hobson, K.A., van Wilgenburg, S.L., Wassenaar, L.I., Larson, K. 2012. Linking hydrogen ($\delta^2\text{H}$) isotopes in feather and precipitation: source of variance and consequences for assignment to isoscapes. *PloS One* 7, e35137.
- Hobson, KA, Wassenaar LI 2008. Tracking animal migration with stable isotopes. Academic Press, London.
- Hoerschelmann, H. 1970. Schnabelform und Nahrungserwerb bei Schnepfenvögeln (Charadriidae und Scolopacidae). *Zool Anz* 184, 302–327.
- Hogan-Warburg, A. J. 1966. Social behavior of ruff *Philomachus pugnax*. *Ardea* 54, 109–229.
- Höglund, J. 1996. Can mating systems affect local extinction risks? Two examples of lek-breeding waders. *Oikos* 77, 184–188.
- Holling, C.S. 1959. Some characteristics of simple types of predation and parasitism. *Can Entomol* 91, 385–398.
- Hooijmeijer, J. 2007. Colour-ringed Ruffs (*Philomachus pugnax*) and Black-tailed Godwits (*Limosa limosa*): two new colour ring projects in The Netherlands. *Aves* 44, 137–140.
- Hornman M., Hustings F., Koffijberg K., Klaassen O., Kleefstra R., van Winden E., Sovon Ganzen en Zwanenwerkgroep, Soldaat L. 2013. Rapport Sovon -Watervogels in Nederland 2011/2012. Sovon Vogelonderzoek Nederland, Nijmegen.
- Hortas, F., Masero, J. 2012. Combatiente. In: Atlas de las aves en invierno en España 2007–2010. del Moral JC, Molina B, Ana Bermejo A, Palomino D (eds.) Ministerio de Agricultura, Alimentacion y Medio Ambiente-SEO/BirdLife, Madrid, pp. 254–255.
- Hulscher, J.B. 1976. Localisation of cockles (*Cardium edule* L.) by the Oystercatcher (*Haematopus ostralegus* L.) in darkness and daylight. *Ardea* 64, 292–310.
- Hurrell, J.W., Kushnir, Y., Ottersen, G., Visbeck, M. 2003. The North Atlantic Oscillation: climatic significance and environmental impact. American Geophysical Union, Washington DC.

I

- IAEA/WMO, 2001. Global network of isotopes in precipitation: the GNIP database. <http://www.iaea.org/water>
- Ims, R.A., Henden, J.A., Killengreen, S.T. 2008. Collapsing population cycles. *Trends Ecol Evol* 23, 79–86.
- Iwamura, T., Fuller, R.A., Possingham, H.P. 2014. Optimal management of a multispecies shorebird flyway under sea-level rise. *Conserv Biol* 28, 1710–1720.
- Iwamura, T., Possingham, H.P., Chadès, I., Minton, C., Murray, N.J., Rogers, D.I., Treml, E.A., Fuller, R.A. 2013. Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations. *Proc R Soc B* 280, 20130325.
- International Wader Study Group, 2003. Are waders world-wide in decline? Reviewing the evidence. *Wader Study Group Bull* 101/102, 8–12.

J

- Jolliffe, I.T. 2002. *Principal component analysis*, 2nd edn. Springer Verlag, New York.
- Jolly, G.M. 1965. Explicit estimates from capture-recapture data with both death and immigration-stochastic model. *Biometrika* 52, 225–247.
- Juillet, C., Choquet, R., Gauthier, G., Lefebvre, J., Pradel, R. 2012. Carry-over effects of spring hunt and climate on recruitment to the natal colony in a migratory species. *J Appl Ecol* 49, 1237–1246.
- Juillet, C., Choquet, R., Gauthier, G., Pradel, R. 2010. A capture–recapture model with double-marking, live and dead encounters, and heterogeneity of reporting due to auxiliary mark loss. *J Agr Biol Environ Stat* 16, 88–104.
- Jukema, J., Piersma, T. 2000. Contour feather moult of ruffs *Philomachus pugnax* during northward migration, with notes on homology of nuptial plumages in scolopacid waders. *Ibis* 142, 289–296.
- Jukema, J., Piersma, T. 2006. Permanent female mimics in a lekking shorebird. *Biol. Lett.* 2, 161–164.
- Jukema, J., Piersma, T., Hulscher, J.B., Bunschoeke, E.J., Koolhaas, A., Veenstra, A. 2001b. Golden Plovers and Wilsternetters: a Deeply Rooted Fascination with Migrating Birds. *Fryske Akademy/KNNV Uitgeverij, Ljouwert/Utrecht, The Netherlands.*
- Jukema, J., Wymenga, E., Piersma, T. 2001a. Stopping over in SW Friesland: fattening and moulting in Ruffs *Philomachus pugnax* during northward migration in the Netherlands. *Limosa* 74, 17–26.
- Karasov, W.H., Martinez del Rio, C. 2007. *Physiological ecology: How animals process energy, nutrients and toxins*. Princeton University Press, Princeton
- Karlionova, N., Meissner, W., Pinchuk, P. 2008. Differential development of breeding plumage in adult and second-year male Ruffs *Philomachus pugnax*. *Ardea* 96, 39–45.
- Kausrud, K.L., Mysterud, A., Steen, H., Vik J.O., Østbye, E., Cazelles, B., Framstad, E., Eikeset, A.M., Mysterud, I., Solhøy, T., Stenseth, N.C. 2008. Linking climate change to lemming cycles. *Nature* 456, 93–97.
- Kempnaers, B., Valcu, M. 2017. Breeding sites sampling across the Arctic by individual males of a polygynous shorebird. *Nature* 541, 528–531.
- Kendall, C. 1998. Tracing nitrogen sources and cycling catchment. In: Kendall C, McDonnell JJ (Eds.) *Isotope tracers in catchment hydrology*. Elsevier, New York, pp. 519–576.
- Kentie, R., Both, C., Hooijmeijer, J.C.E.W., Piersma T. 2014. Age-dependent dispersal and habitat choice in black-tailed godwits *Limosa limosa limosa* across a mosaic of traditional and modern grassland habitats. *J Avian Biol* 45, 396–405.

- Kentie, R., Both C., Hooijmeijer J.C.E.W, Piersma, T., Smart J., Nager R. 2015. Management of modern agricultural landscapes increases nest predation rates in Black-tailed Godwits *Limosa limosa*. Ibis 157, 614–625.
- Kentie, R., Hooijmeijer J.C.E.W., Trimbos K.B., Groen N.M., Piersma T. 2013. Intensified agricultural use of grasslands reduces growth and survival of precocial shorebird chicks. J. Appl. Ecol. 50, 243–251.
- Kentie, R., Márquez-Ferrando, R., Figuerola, J., Gangoso, L., Hooijmeijer, J.C.E.W., Loonstra, A.H.J., Robin, F., Sarasa, M., Senner, N., Valkema, H., Verhoeven, M.A., Piersma, T. 2017. Does wintering north or south of the Sahara correlate with timing and breeding performance in black-tailed godwits? Ecol Evol 7, 2812–2820.
- Kentie R., Senner N.R., Hooijmeijer J.C.E.W., Márquez-Ferrando R., Figuerola J., Masero J.A., Verhoeven M.A., Piersma T. 2016. Estimating the size of the Dutch breeding population of Continental Black-tailed Godwits from 2007–2015 using resighting data from spring staging sites. Ardea 114, 213–225.
- Klaassen, M., Piersma, T., Korthals, H., Dekinga, A., Dietz, M. 2010. Single-point isotope measurements in blood cells and plasma to estimate the time since diet switches. Funct Ecol 24, 796–804.
- Kleijn, D., Berendse, F., Smit, R., Gilissen, N. 2001. Agri-environment schemes do not effectively protect biodiversity in Dutch agricultural landscapes. Nature 413, 723–725.
- Kleijn, D., Kohler, F., Báldi, A., Batáry, P., Concepción, E.D., Clough, Y., Díaz, M., Gabriel, D., Holzschuh, A., Knop, E., Kovács, A., Marshall, E.J.P., Tschamntke, T., Verhulst, J. 2009. On the relationship between farmland biodiversity and land-use intensity in Europe. Proc. R. Soc. B 2009 276, 903–909.
- Kleijn, D., Schekkerman H., Dimmers, W.J., van Kats, R.J.M., Melman, D., Teunissen, W.A. 2010. Adverse effects of agricultural intensification and climate change on breeding habitat quality of Black-tailed Godwits *Limosa l. limosa* in The Netherlands. Ibis 152, 475–486.
- Kone, B., Diallo, M., Fofana, B. 2002. Exploitation des oiseaux d'eau. In: Wymenga E, Kone B, van der Kamp J, Zwartz L (eds.) Delta intérieur du fleuve Niger: Ecologie et gestion durable des ressources naturelles. A&W/Wetlands International/Rijkswaterstaat, Veenwouden, pp. 201–207.
- Koopman, K. 1986. Primary moult and weight changes of ruffs in the Netherlands in relation to migration. Ardea 74, 69–77.
- Krupa, M., Sciborski, M., Krupa, R., Popis, R., Woloszyn, J. 2009. Differences in foraging ecology of Wood Sandpiper *Tringa glareola* and Ruff *Philomachus pugnax* during spring migration in Sajna River valley (northern Poland). Ornis Svec 19, 90–96.
- Küpper, C., Stocks, M., Risse, J.E., dos Remedios, N., Farrell, L.L., McRae, S.B., Morgan, T.C., Karlionova, N., Pinchuk, P., Verkuil, Y.I., Kitaysky, A.S., Wingfield, J.C., Piersma, T., Zeng, K., Slate, J., Blaxter, M., Lank, D.B., Burke, T. 2014. A supergene determines highly divergent male reproductive morphs in the ruff. Nature, 48, 79–83.
- L**
- Lancot, R.B., Weatherhead, P.J. 1997. Ephemeral lekking behavior in the buff-breasted sandpiper, *Tryngites subruficollis*. Behav Ecol 8, 268–278.
- Lange, G. 1968. Über Nahrung, Nahrungsaufnahme und Verdauungstrakt mitteleuropäischer Limicolen. Beitr Vogelk 13, 225–334.
- Lank, D.B., Smith, C.M., Hanotte, O., Burke, T., Cooke, F. 1995. Genetic polymorphism for alternative mating behavior in lekking male ruff *Philomachus pugnax*. Nature 378, 59–62.

- Lebreton, J.D., Burnham, K.P., Clobert, J., Anderson, D.R. 1992. Modeling survival and testing biological hypotheses using marked animals: a unified approach with case studies. *Ecol Monogr* 62, 67–118.
- Lee, A.M., Saether, B.E., Engen, S. 2011. Demographic stochasticity, allee effects, and extinction: the influence of mating system and sex ratio. *Am Nat* 177, 301–313.
- Lenth, R.V. 2016. Least-squares means: The R package lsmeans. *J Stat Softw* 69, 1–33.
- Lesku, J.A., Rattenborg, N.C., Valcu, M., Vyssotski, A., Kuhn, S., Kuemmeth, F., Hiedrich, W., Kempenars, B. 2012. Adaptive sleep loss in polygynous Pectoral sandpipers. *Science* 337, 1654–1658.
- Limburg, K.E., Waldman, J.R. 2009. Dramatic declines in North Atlantic diadromous fishes. *Bioscience* 59, 955–965.
- Lindström, Å., Green, M. 2013. Monitoring population changes of birds in Sweden. Annual report for 2012. Department of Ecology, Lund University.
- Limburg, K.E., Waldman, J.R. 2009. The dramatic declines in North Atlantic diadromous fishes. *Bioscience* 59, 955–965.
- López-Calderón, C., Hobson, K.A., Marzal, A., Balbontín, J., Reviriego, M., Magallanes, S., García-Longoria, L., de Lope, F., Møller, A.P. 2017. Wintering areas predict age-related breeding phenology in a migratory passerine bird. *J Avian Biol*, 48, 631–639.
- Lourenço, P.M., Silva, A., Santos, C.D., Miranda, A.C., Granadeiro, J.P., Palmeirim, J.M. 2008. The energetic importance of night foraging for waders wintering in a temperate estuary. *Acta Oecol* 34, 122–129.
- Lundberg, J., Moberg, F. 2003. Mobile link organisms and ecosystem functioning: implications for ecosystems resilience and management. *Ecosystems* 6, 87–98.
- M**
- Ma, Z., Cai, Y., Li, B., Chen, J. 2010. Managing wetland habitats for waterbirds: an international perspective. *Wetlands* 30, 15–27.
- MacArthur, R.H., Pianka, E.R. 1966. On optimal use of a patchy environment. *Am Nat* 100, 603–609.
- MacDonald, D.W. 1983. Predation on earthworms by terrestrial vertebrates. (ed J.E. Satchell) *Earthworm ecology: from Darwin to vermiculture*, pp. 393–414. Chapman & Hall, London.
- Márquez-Ferrando, R., Figuerola, J., Hooijmeijer, J.C.E.W., Piersma, T. 2014. Recently created man-made habitats in Doñana provide alternative wintering space for the threatened continental European black-tailed godwit population. *Biol Cons* 171, 127–135.
- Marra, P.P., Hobson, K.A., Holmes, R.T. 1998. Linking winter and summer events in a migratory bird by stable-carbon isotope. *Science* 282, 1884–1886.
- Martin, G. 1990. *Birds by night*. Poyser, London.
- Martin, G.R., Piersma, T. 2009. Vision and touch in relation to foraging and predator detection: insightful contrasts between a plover and a sandpiper. *Proc R Soc B* 276, 437–445.
- Matson, P.A., Parton, W.J., Power, A.G., Swift, M.J. 1997. Agriculture intensification and ecosystem properties. *Science* 277, 504–509.
- McKay, A.F., Hoye, B.J. 2016. Are migratory animals super spreader of infections? An introduction to the Symposium. *Integr Comp Biol* 56, 260–267.
- McCracken, D.I., Tallwin J.R. 2004. Swards and structure: the interactions between farming practices and bird food resources in lowland grasslands. *Ibis* 146, 108–114.
- McKinnon, L., Berteaux, D., Bêty, J. 2014. Predator-mediated interactions between lemmings and shorebirds: a test of the alternative prey hypothesis. *Auk* 131, 619–628.
- McNeil, R., Drapeau, P., Goss-Custard, J.D. 1992. The occurrence and adaptive significance of

- nocturnal habits in waterfowl. *Biol Rev* 67, 381–419.
- McNeil, R., Rodríguez, J.R. 1996. Nocturnal foraging in shorebirds. *Int. Wader Studies* 8: 114–121.
- Meissner, W., Scebba, S. 2005. Intermediate stages of age characters create dilemmas in ageing female Ruffs *Philomachus pugnax* in spring. *Wader Study Group Bull* 106, 30–33.
- Meissner, W., Ziêcik, P. 2005. Biometrics of juvenile Ruffs (*Philomachus pugnax*) migrating in autumn through the Puck Bay region (N Poland). *Ring* 27, 189–196.
- Melter, J., Sauvage, A. 1997. Measurements and moult of ruffs *Philomachus pugnax* wintering in West Africa. *Malimbus* 19, 12–18.
- Meltofte, H., Piersma, T., Boyd, H., McCaffery, B., Ganter, B., Golovnyuk, V V, Graham, K., Gratto-Trevor, C.L., Morrison, R.I.G., Nol, E., Rösner, H.U., Schamel, D., Schekkerman, H., Soloviev, M.Y., Tomkovich, P.T., Tracy, C.M., Tulp, I., Wennerberg, L. 2007. Effects of climate variation on the breeding ecology of Arctic shorebirds. *Meddelelser om Grønland Bioscience* 59. Danish Polar Center 2007, Copenhagen.
- Minias, P., Kaczmarek, K. 2013. Population-wide body mass increment at stopover sites is an unreliable indicator of refueling rates in migratory waders. *Ibis* 155, 102–112.
- Montgomerie, R., Weatherhead, P.J. 1997. How Robins find worms. *Anim Behav* 54, 143–151.
- Mouritsen, K.N. 1994. Day and night feeding in Dunlins *Calidris alpina*: choice of habitat, foraging technique and prey. *J Avian Biol* 25, 55–62.
- Murray, N. J., Phinn, S. R., Clemens, R. S., Roelfsema, C. M., Fuller, R. A. 2012. Continental scale mapping of tidal flats across East Asia using the Landsat archive. *Remote Sens.* 4, 3417–3426.
- N**
- Navedo, J.G., Hahn, S., Parebo, M., Abad-Gómez, J.M., Gutiérrez, J.S., Villegas, A., Sánchez-Guzmán, J.M., Masero, J.A. 2015. Unravelling trophic subsidies of agroecosystems for biodiversity conservation: food consumption and nutrient recycling by waterbirds in Mediterranean rice fields. *Sci Total Environ* 511, 288–297.
- Newton, I. 2004. Population limitations in migrants. *Ibis* 146, 197–226.
- Newton, I. 2006. Can condition experienced during migration limit the population levels of birds? *J Ornitho* 147, 146–166.
- Newton, I., 2008. *The migration ecology of birds*. Academic Press, Amsterdam.
- O**
- OAG Münster 1998. Mass of ruffs *Philomachus pugnax* wintering in West Africa. *Int Wader Stud* 10, 435–440.
- Øien, I.J., Aarvak T. 2010. Brushanen forsvinner. *Vår Fuglefauna* 33, 162–173.
- Ondersteijn, C.M.J., Beldman, A.C.G., Daatselaar, C.H.G, Giesen, G.W.J., Huirne, R.B.M. 2003. Farm structure or farm management: effective ways to reduce nutrient surpluses on dairy farms and their financial impacts. *Livest Prod Sci* 84, 171–181.
- Onrust, J. 2017. *Earth, worms & birds*. PhD dissertation, Royal University of Groningen, Groningen, The Netherlands.
- Onrust, J., Loonstra, A.H.J, Schmaltz, L.E., Verkuil, Y.I., Hooijmeijer, J.C.E.W., Piersma, T. 2017. Detection of earthworm prey by ruffs *Philomachus pugnax*. *Ibis* 159, 647–656.
- Oppel, S., Pain, D.J., Lindsell, J.A., Lachmann, L., Diop, I., Tegetmeyer, C., Donald, P.F., Anderson, G., Bowden, G.R., Tanneberger, F., Flade, M. 2011. High variation reduces the value of feather stable isotope ratios in identifying new wintering areas for aquatic warblers *Acrocephalus paludicola* in West Africa. *J Avian Biol* 42, 342–354.

- Ouwehand, J., Ahola, M.P., Ausems, A.N.M.A., Bridge, E.S., Burgess, M., Hahn, S., Hewson, C.M., Klaassen, R.H.G., Laaksonen, T., Lampe, H.M., Velmalala, W., Both, C. 2015. Light-level geolocators reveal migratory connectivity in European populations of pied flycatchers *Ficedula hypoleuca*. *J Avian Biol* 47, 69–83.
- P**
- Pearson, D.J. 1981. The wintering and moult of ruffs *Philomachus pugnax* in the Kenyan Rift valley. *Ibis* 123, 158–182.
- Pearce-Higgins, J.W., Yalden, D.W., Whittingham, M.J. 2005. Warmer springs advance the breeding phenology of Golden Plovers *Pluvialis apricaria* and their prey (*Tipulidae*). *Oecologia* 143, 470–476.
- Pernollet, C.A., Guelmami, A., Green, A.J., Curcó Masip, A., Dies, B., Bogliani, G., Tesio, F., Brogi, A., Gauthier-Clerc, M., Guillemain, M. 2015. A comparison of wintering duck numbers among European rice production areas with contrasting flooding regimes. *Biol Cons* 186, 214–224.
- Peterson, B.J., Fry, B. 1987. Stable isotopes in ecosystem studies. *Annu Rev Ecol Syst* 18, 293–320.
- Piersma, T. 1983. Communal roosting of Black-tailed Godwits *Limosa limosa* on the Mokkebank. *Limosa* 56, 1–8.
- Piersma, T. 2007. Using the power of comparison to explain habitat use and migration strategies of shorebirds worldwide. *J Ornithol* 148, S45–S59.
- Piersma, T. 2011. From spoonbill to Spoon-billed Sandpiper: the perceptual dimensions to the niche. *Ibis* 153, 659–661.
- Piersma, T. 2012. What is habitat quality? Dissecting a research portfolio on shorebirds. In: Fuller, R.J. (ed) *Birds and habitat: relationships in changing landscapes*. Cambridge University Press, Cambridge, pp. 383–407.
- Piersma, T., Baker, A.J. 2000. Life history characteristics and the conservation of migratory shorebirds. In: Gosling L.M. & Sutherland W.J. (eds) *Behaviour and Conservation*. Cambridge University Press, Cambridge, pp. 105–124.
- Piersma, T., Lindström, Å. 2004. Migrating shorebirds as integrative sentinels of global environmental change. *Ibis* 146, 61–69.
- Piersma, T., Koolhaas, A., Dekinga, A., Beukema, J.J., Dekker, R., Essink, K. 2001. Long-term indirect effects of mechanical cockle-dredging on intertidal bivalve stocks in the Wadden Sea. *J Appl. Ecol.* 38, 976–990.
- Piersma, T., Lok, T., Chen, Y., Hassell, C.J., Yang, H.Y., Boyle, A., Slaymaker, M., Chan, Y.C., Melville, D.S., Zhang, Z.W., Ma, Z. 2016. Simultaneous declines in summer survival of three shorebird species signals a flyway at risk. *J Appl Ecol* 53, 479–490.
- Piersma, T., Rogers, K.G., Boyd, H., Bunschoke, E.J., Jukema, J. 2005a. Demography of Eurasian Golden Plovers *Pluvialis apricaria* staging in The Netherlands, 1949–2000. *Ardea* 93, 49–64.
- Piersma, T., Rogers, D.I., Gonzalez, P.M., Zwarts, L., Niles, L.J., de Lima S.do Nascimento, I., Minton, C.D.T., Baker, A.J. 2005b. Fuel storage rates before northward flights in red knots worldwide: facing the severest ecological constraint in tropical intertidal environments? In: Greenberg, R. and Marra, P. P. (eds.), *Birds of two worlds: ecology and evolution of migration*. Baltimore: Johns Hopkins University Press, pp. 262–273.
- Piersma, T., van Gils, J.A. 2011. *The flexible phenotype, a body-centred integration of ecology, physiology and behaviour*. Oxford University Press, Oxford.
- Piersma, T., van Gils, J.A., Wiersma, P. 1996. Family Scolopacidae (sandpipers & allies). In: del Hoyo, J., Elliot, A. & Sargital, J. (eds) *Handbook of Birds of the World, Vol. 3. Hoatzins to Auks*. Lynx Editions, Barcelona, pp. 444–533.

- Post, D.M. 2002. Using stable isotopes to estimate trophic position: models, methods, and assumptions. *Ecology* 83, 703–718.
- Pradel, R. 1996. Utilization of Mark-Capture-Recapture for the study of recruitment and population growth rate. *Biometrics* 52, 703–709.
- Pradel, R. 2005. Multievent: an extension of multistate capture-recapture models to uncertain states. *Biometrics* 61, 442–447.
- Pradel, R., Hines, J.E., Lebreton, J.D., Nichols, J.D. 1997. Capture-Recapture Survival Models Taking Account of Transients. *Biometrics* 53, 60–72.
- Pradel, R., Gimenez, O., Lebreton, J.D. 2005. Principles and interest of GOF tests for multi-state capture – recapture models. *Animal Biodiversity and Conservation* 28, 189–204.
- Pradel, R., Sanz-Aguilar, A. 2012. Modeling trap-awareness and related phenomena in capture-recapture studies. *Plos One* 7, e32666.
- Prater, A.J. 1973. The wintering population of Ruffs in Britain and Ireland. *Bird Study* 20, 245–250.
- Prater, A.J., Marchant, J.H., Vuorinen, J. 1977. Guide to the identification and ageing of Holarctic waders. British Trust for Ornithology, U.K.
- Pritchard, G. 1983. Biology of Tipulidae. *Annu Rev Entomol* 28, 1–22.

Q

- Qninba, A., Dakki, M., Benhoussa, A., El-Agbani, M.A. 2006. Rôle de la côte Atlantique marocaine dans l'hivernage des limicoles (Aves, Charadrii). *Ostrich* 78, 489–493.

R

- R Development Core Team, 2008. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>
- Rakhimberdiev, E., Verkuil, Y.I., Saveliev, A.A., Väisänen, R.A., Karagicheva, J., Soloviev, M.Y., Tomkovich, P.S., Piersma, T. 2011. A global population redistribution in a migrant shorebird detected with continent-wide qualitative breeding survey data. *Divers Distrib* 17, 144–151.
- Raw, F. 1966. The soil fauna as a food source for moles. *J Zool Lond* 149, 50–54.
- Robert, M., McNeil, R. 1989. Comparative day and night feeding strategies of shorebird species in a tropical environment. *Ibis* 131, 69–79.
- Rogers, D.I., Piersma, T., Hassell, C.J. 2006. Roost availability may constrain shorebird distribution: exploring the energetic costs of roosting and disturbance around a tropical bay. *Biol Conserv* 133, 225–235.
- Rojas, L.M., McNeil, R., Cabana, T., Lachapelle, P. 1999. Diurnal and nocturnal visual capabilities in shorebirds as a function of their feeding strategies. *Brain Behav Evol* 53, 29–43.
- Roodbergen, M., van der Werf, B., Hötker, H. 2012. Revealing the contributions of reproduction and survival to the Europe-wide decline in meadow birds: review and meta-analysis. *J Ornithol* 153, 53–74.
- Rowe, S., Hutchings, J.A. 2003. Mating systems and the conservation of commercially exploited fish. *TREE* 18, 567–572.
- Runge, C.A., Watson, J.E.M., Butchart, S.H.M., Hanson, J.O., Possingham, H.P., Fuller, R.A. 2015. Protected areas and global conservation of migratory birds. *Science* 350, 1255–1257.

S

- Sæther, B.E., Bakke, Ø. 2000. Avian life history variation and contribution of demographic traits to the population growth rate. *Ecology* 81, 642–653.

- Sánchez-Guzmán, J.M., Morán, R., Masero, J.A., Corbacho, C., Costillo, E., Villegas, A., Santiago-Quesada, F. 2007. Identifying new buffer areas for conserving waterbirds in the Mediterranean basin: the importance of the rice in Extremadura, Spain. *Biodivers Conserv* 16, 3333–3344.
- Sanders, M.D. 2000. Enhancing food supplies for waders: inconsistent effects of substratum manipulations on aquatic invertebrate biomass. *J Appl Ecol* 37, 66–76.
- Sanderson, F.J., Donald, P.F., Pain, D.J., Burfield, I.J., van Bommel, F.P.J. 2006. Long-term population declines in Afro-Palaearctic migrant birds. *Biol Conserv* 131, 93–105.
- Sanz-Aguilar, A., Tavecchia, G., Genovart, M., Igual, J.M., Oro, D., Rouan, L., Pradel, R. 2011. Studying the reproductive skipping behavior in long-lived birds by adding nest-inspection to individual-based data. *Ecol Appl* 21, 555–564.
- Schaub, M., Abadi F. 2011. Integrated population models: a novel analysis framework for deeper insights into population dynamics. *J Ornithol* 152, S227–S237.
- Schaub, M., Pradel, R., Jenni, L., Lebreton, J.D. 2001. Migrating birds stop over longer than usually thought: an improved capture-recapture analysis. *Ecology* 82, 852–859.
- Schekkerman, H., Beintema, A.J. 2007. Abundance of invertebrates and foraging success of Black-tailed Godwit *Limosa limosa* chicks in relation to agricultural grassland management. *Ardea* 95, 39–54.
- Schekkerman, H., Teunissen, W., Oosterveld, E. 2008. The effect of mosaic management on the demography of Black-tailed Godwit *Limosa limosa* on farmland. *J Appl Ecol* 45, 1067–1075.
- Scheufler, H. Stiefel, A. 1985. *Der Kemppläufer*. A. Ziemsen Verlag, Wittenberg, Lutherstadt.
- Schmaltz, L.E., Juillet, C., Tinbergen, J.M., Verkuil, Y.I., Hooijmeijer, J.C.E.W., Piersma, T. 2015. Apparent annual survival of staging ruffs during a period of population decline : insights from sex and site-use related differences. *Popul Ecol* 57, 613–624.
- Schmaltz, L.E., Loonstra, A.H.J., Wymenga, E., Hobson, K.A., Piersma, T. 2017. Quantifying the non-breeding provenance of staging Ruffs, *Philomachus pugnax*, using stable isotope analysis of different tissues. *J Ornitho* 159, 191–203.
- Schmaltz, L.E., Vega, M.L., Verkuil, Y.I., Hooimeijer, J.C.E.W., Piersma, T. 2016. Use of agricultural fields by ruffs in southwest Friesland in 2003–2013. *Ardea* 104, 23–32.
- Seber, G.A.F. 1965. A note on multiple-recapture census. *Biometrika* 52, 249–259.
- Seber, G.A.F. 1982. The estimation of animal abundance and related parameters. Second edition. Macmillan, New York, USA.
- Skagen, S.K., Bart, J., Andres, B., Brown, S., Donaldson, G., Harrington, B., Johnston, V., Jones, S.L., Morrison, R.I.G. 2003. Monitoring the shorebirds of North America: towards a unified approach. *Wader Study Group Bull* 100, 102–104.
- Steffen, W., Persson, Å., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., Crumley, C., Crutzen, P., Folke, C., Gordon, L., Molina, M., Ramanathan, V., Rockström, J., Scheffer, M., Schellnhuber, H.J., Svedin, U. 2011. The Anthropocene: from global change to planetary stewardship. *Ambio* 40, 739–761.
- Stenseth, N.C., Ottersen, G., Hurrell, J.W., Mysterud, A., Lima, M., Chan, K.S., Yoccoz, N.G., Ådlandsvik, B. 2003. Studying climate effects on ecology through the use of climate indices: the North Atlantic Oscillation, El Niño Southern Oscillation and beyond. *Proc R Soc B-Biol Sci* 270, 2087–2096.
- Stroud, D.A., Baker, A.J., Blanco, D.E., Davidson, N.C., Delany, S.N., Ganter, B., Gill, R.E., Gonzalez, P.M., Haanstra, L., Morrison, R.I.G., Piersma, T., Scott, D., Thorup, O., West, R., Wilson, J.L., Zöckler, C. 2006. The conservation and population status of the world's waders at the turn of the millennium. In G. C. Boere, C. A. Galbraith, & D. A. Stroud (Eds.), *Waterbirds around the world* (pp. 643–648). Edinburgh, UK: The Stationery Office.

- Studds, C.E., Kendall, B.E., Murray, N.J., Wilson, H.B., Roger, D., Clemens, R.S., Gosbell, K., Hassel, C.J., Jessop, R., Melville, D.S., Milton, D.A., Possingham, H.P., Riegen, A.C., Straw, P., Woehler, E.J., Fuller, R.A. 2017. Rapid population decline in migratory shorebirds relying on Yellow Sea tidal mudflats as stopover sites. *Nat comm* 8, 14895.
- Sutherland, W.J., Alves, J.A., Amano, T., Chang, C.H., Davidson, N.C., Finlayson, C.M., Gill, J.A., González, P.M., Gunnarsson, T.G., Kleijn, D., Spray, C.J., Székely, T., Thompson, D.B.A. 2012. A horizon scanning assessment of current and potential future threats to migratory shorebirds. *Ibis* 154, 663–679.
- T**
- Taylor, C.M., Norris, D.R. 2007. Predicting conditions for migration: effects of density dependence and habitat quality. *Biol Lett* 3, 280–284.
- Taylor, C.M., Norris, D.R. 2010. Population dynamics in migratory networks. *Theor Ecol* 3, 65–73.
- Thomas, R.J., Székely, T., Powell, R.F., Cuthill, I.C. 2006. Eye size, foraging methods and the timing of foraging in shorebirds. *Funct Ecol* 20, 157–165.
- Thorup, O. 2006. Breeding Waders in Europe 2000. *International Wader Studies* 14, 1–142.
- United Nations, 2015. Transforming our world: the 2030 agenda for sustainable development. <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>
- Thorup, K., Korner-Nievergelt, F., Cohen, E.B., Baillie, S.R. 2014. Large-scale spatial analysis of ringing and re-encounter data to infer movement patterns: a review including methodological perspectives. *Methods Ecol Evol* 5, 1137–1350.
- Tøttrup, A.P., Klaassen, R.H.G., Strandberg, R., Thorup, K., Kristensen, M.W., Jørgensen, P.S., Fox, J., Afanasyev, V., Rahbek, C., Alerstam, T. 2012 The annual cycle of a trans-equatorial Eurasian-African passerine migrant : different spatio-temporal strategies for autumn and spring migration. *Proc R Soc B* 279, 1008–1016.
- Trivers, R.L. 1972. Parental investment and sexual selection. In: Campbell B (ed) *Sexual selection and the descent of man 1871–1971*. Aldine, Chicago, pp. 136–179.
- Tréca, B. 1990. Régimes et préférences alimentaires d’anatidés et de scolopacidés dans le delta du Sénégal, études de leur capacités d’adaptation aux modifications du milieu. Exploitation des milieux cultivés. PhD thesis.
- Tréca, B. 1994. The diet of ruffs and Black-tailed Godwits in Senegal. *Ostrich* 65, 256–263.
- Triplet, P., Diop, I., Sylla, S.I., Schricke, V. 2014. Les oiseaux d’eau dans le delta du fleuve Sénégal (rive gauche). Bilan de 25 années de dénombrements hivernaux (mi-janvier 1989–2014). OMPO, ONCFS, DPN, SMBS, 125 p
- V**
- Väisänen, R.A. 2005. Monitoring population changes of 86 land bird species breeding in Finland in 1983–2005. *Linnut-Vuosikirja* 2005, 83–98.
- van der Kamp, J., Diallo, M., Fofana, B. 2002a. Dynamique des populations d’oiseaux d’eau. In: Wymenga, E., B. Kone, J. van der Kamp, L. Zwartz (Eds.) *Delta Intérieur du Niger: Ecologie et gestion durable des ressources naturelles*. A&W/Wetlands International/Rijkswaterstaat, Veenwouden, pp. 87–140.
- van der Kamp, J., Zwartz, L., Diallo, M., 2002b. Niveaux de crue, oiseaux d’eau et ressources alimentaires disponibles. In: Wymenga, E., B. Kone, J. van der Kamp, L. Zwartz (Eds.) *Delta Intérieur du Niger: Ecologie et gestion durable des ressources naturelles*. A&W/Wetlands International/Rijkswaterstaat, Veenwouden, pp. 141–161.

- van Gils, J.A., Ahmedou Salem, M.V. 2015. Validating the incorporation of ^{13}C and ^{15}N in a shorebird that consumes an isotopically distinct chemosymbiotic bivalve. *PLoS One* 10, e0140221.
- van Gils, J.A., Lisovski, S., Lok, T., Meissner, W., Ożarowska, A., de Fouw, J., Rakhimberdiev, E., Soloviev, M.Y., Piersma, T., Klaassen, M. 2016. Body shrinkage due to Arctic warming reduces red knot fitness in tropical wintering range. *Science* 6287, 819–821.
- van Gils, J.A., Spaans, B., Dekinga, A. & Piersma, T. 2006. Foraging in a tidally structured environment by Red Knots (*Calidris canutus*): ideal, but not free. *Ecology* 87, 1189–1202.
- van Paassen, A., Roetemeijer, W. 2006. Jaarverslag Weidevogelbescherming en beheer in Nederland 2005. Landschapsbeheer Nederland, Utrecht.
- van Rhijn, J.G. 1973. Behavioural dimorphism in male Ruffs, *Philomachus pugnax*. *Behaviour* 47, 153–229.
- van Rhijn, J.G. 1991. The ruff: individuality in a gregarious wading bird. T. & A.D. Poyser, London.
- van Rhijn, J.G., Jukema, J., Piersma, T. 2014. Diversity of nuptial plumage in male Ruffs *Philomachus pugnax*. *Ardea* 102, 5–20.
- van Wijk, R.E., Kölzsch, A., Kruckenberg, H., Ebbsing, B.S., Müskens, G.J.D.M., Nolet, B.A. 2012. Individually tracked geese follow peaks of temperature acceleration during spring migration. *Oikos* 121, 655–664.
- Verhulst, J., Kleijn, D., Berendse, F. 2007. Direct and indirect effects of the most widely implemented Dutch agri-environment schemes on breeding waders. *J Appl Ecol* 44, 70–80.
- Verkuil, Y.I., de Goeij, P. 2003. Do reeves make different choices? Meadow selection by spring staging Ruffs *Philomachus pugnax* in Southwest Friesland. *Limosa* 76, 157–168.
- Verkuil, Y.I., Karlionova, N., Rakhimberdiev, E., Jukema, J., Wijmenga, J.J., Hooijmeijer, J.C.E.W., Pinchuk, P., Wymenga, E., Baker, A.J., Piersma, T. 2012a. Losing a staging area : eastward redistribution of Afro-Eurasian Ruffs is associated with deteriorating fuelling conditions along the western flyway. *Biol Conserv* 149, 51–59.
- Verkuil, Y.I., Piersma, T., Jukema, J., Hooijmeijer, J.C.E.W., Zwarts, L., Baker, A.J. 2012b. The interplay between habitat availability and population differentiation: a case study on genetic and morphological structure in an inland wader (Charadriiformes). *Biol J Linn Soc* 106, 641–656.
- Verkuil, Y.I., Wijmenga, J.J., Hooijmeijer, J.C.E.W., Piersma, T. 2010. Spring migration of ruffs *Philomachus pugnax* in Fryslân: estimates of staging duration using resighting data. *Ardea* 98, 21–33.
- Vickery, J.A., Ewing, S.R., Smith, K.E.N.W., Pain, D.J., Bairlein, F., Gregory, R.D., Skorpilov, J. 2014. The decline of Afro-Palaearctic migrants and an assessment of potential causes. *Ibis* 156, 1–22.
- Vickery, J.A., Tallowin, J.R., Feber, R.E., Asteraki, E.J., Atkinson, P.W., Fuller, R.J., Brown, V.K. 2001. The management of lowland neutral grasslands in Britain: effects of agricultural practices on birds and their food resources. *J. Appl. Ecol.* 38, 647–664.
- Virkkala, R., Rajasärkkä, A. 2011. Northward density shift of bird species in boreal protected areas due to climate change. *Boreal Environ Res* 16, 2–13.

W

- Wassenaar, L.I., Hobson, K.A. 2003. Comparative equilibration and online technique for determination of non-exchangeable hydrogen of keratins for use in animal migration studies. *Isot Environ Healt S* 39, 211–217.
- Webster, M.S., Marra, P.P., Haig, S.M., Bensch, S., Holmes, R.T. 2002. Links between worlds: unraveling migratory connectivity. *Trends Ecol Evol* 17, 76–83.

- Werner, S.J., Hobson, K.A., Van Wilgenburg, S., Fischer, J.W. 2016. Multi-Isotopic ($\delta^2\text{H}$, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$) tracing of moult origin for Red-winged Blackbirds associated with agro-ecosystems. *PLoS One* 11, e0165996.
- Wetering, S., Osterveld, E., Oud, H. 2014. Effecten van plas-dras op weidevogels in Noordoost-Fryslân en de rol in netwerkpopulaties. *De levende natuur* 116, 59–64.
- Widemo, F. 1998. Alternative reproductive strategies in the ruff, *Philomachus pugnax*: a mixed ESS? *Anim. Behav* 56, 329–336.
- Wilcove, D.S., Wikelski, M. 2008. Going, going gone: is animal migration disappearing? *PLoS Biol* 6, e188.
- Wymenga, E. 1999. Migrating ruffs, *Philomachus pugnax*, through Europe, spring 1998. *Wader Study Group Bull* 88, 43–48.
- Wymenga, E., Kone, B., van der Kamp, J., Zwarts, L. 2002. Delta intérieur du fleuve Niger: Ecologie et gestion durable des ressources naturelles. A&W/Wetlands International/Rijks-waterstaat, Veenwouden.
- Wymenga, E., Zwarts, L. 2010. Use of rice fields by birds in West Africa. *Waterbirds* 33, 97–104.

Y

- Yang, H.Y., Chen, B., Barter, M., Piersma, T., Zhou, C.F., Li, F.S., Zhang, Z.W. 2011. Impacts of tidal land reclamation in Bohai Bay, China: ongoing losses of critical Yellow Sea waterbird staging and wintering sites. *Bird Conserv Int* 21, 241–259.
- Yerkes, T., Hobson, K.A., Wassenaar, L.I., MacLeod, R., Colucci, J.M. 2008. Stable isotopes ($\delta^2\text{H}$, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$) reveal associations among geographical location and condition of Alaskan northern pintails. *J Wildl Manage* 72, 715–725.

Z

- Zöckler, C. 2002a. Declining ruff *Philomachus pugnax* populations: a response to global warming? *Wader Study Group Bull* 97, 19–29.
- Zöckler, C. 2002b. A comparison between tundra and wet grassland breeding waders with special reference to the Ruff (*Philomachus pugnax*). Federal Agency for Nature Conservation, Bonn, Germany.
- Zwarts, L., Bijlsma, R.G., van der Kamp, J., Wymenga, E. 2009. *Living on the Edge: Wetlands and Birds in a Changing Sahel*. KNNV Publishing, Zeist, the Netherlands.
- Zwarts, L., Wanink, J.H. 1993. How the food supply harvestable by waders in the Wadden Sea depends on the variation in energy density, body weight, biomass, burying depth and behavior of tidal flat invertebrates. *Neth J Sea Res* 31, 441–476.

