

Title	Discrete-space continuous-time models of marine mammal exposure to Navy sonar
Authors	Jones-Todd, Charlotte M.;Pirodda, Enrico;Durban, John W.;Claridge, Diane E.;Baird, Robin W.;Falcone, Erin A.;Schorr, Gregory S.;Watwood, Stephanie;Thomas, Len
Publication date	2021-10-15
Original Citation	Jones-Todd, C. M., Pirodda, E., Durban, J. W., Claridge, D. E., Baird, R. W., Falcone, E. A., Schorr, G. S., Watwood, S. and Thomas, L. (2021), 'Discrete-space continuous-time models of marine mammal exposure to Navy sonar', Ecological Applications, 32(1), e02475 (13pp). https://doi.org/10.1002/eap.2475
Type of publication	Article (peer-reviewed)
Link to publisher's version	10.1002/eap.2475
Rights	© 2021, John Wiley & Sons, Inc. This is the peer reviewed version of the following item: Jones-Todd, C. M., Pirodda, E., Durban, J. W., Claridge, D. E., Baird, R. W., Falcone, E. A., Schorr, G. S., Watwood, S. and Thomas, L. (2021), 'Discrete-space continuous-time models of marine mammal exposure to Navy sonar', Ecological Applications, doi: 10.1002/eap.2475, which has been published in final form at https://doi.org/10.1002/eap.2475 . This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions
Download date	2026-08-10 03:39:51
Item downloaded from	https://hdl.handle.net/10468/12112



University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Supporting Information: Jones-Todd, C. M., E. Pirotta, J. W. Durban, D. E. Claridge, R. W. Baird, E. A. Falcone, G. S. Schorr, S. Watwood, and L. Thomas. Discrete-space continuous-time models of marine mammal exposure to Navy sonar. *Ecological Applications*.

Appendix S3. Software implementation

Functionality to fit the models discussed in Section [Discrete-space continuous-time Markov model](#) of the manuscript is available through the `mmre` (Jones-Todd, 2021) R package (see, <https://doi.org/10.5281/zenodo.4876540>); parameter estimates are obtained via minimization of the negative log-likelihood discussed in [Likelihood](#). The package makes use of Template Model Builder (TMB) (Kristensen et al., 2016), which implements automatic differentiation and applied Laplace approximation to fit complex random-effect models (see Kristensen et al. (2016) for details). In the `mmre` package, we construct specific C++ templates for the models detailed above.

Once `mmre` is installed (`devtools::install_github('cmjt/mmre')`) and the required C++ templates are compiled (`mmre::compile.mmre()`) and loaded (`mmre::dll.mmre()`), the model given by Equation 2 (of the manuscript) can be fitted to example data by running the following R code.

```
library(mmre)
fit.mmre(example$data, parameters = example$parameters.decay.re,
decay = TRUE, cov.names = "t.since")
```

Running `get.coefs(...)` will print out the estimated parameter values and associated standard errors. For further functionality, see Jones-Todd (2021).

Note that the example data provided with `mmre` (Jones-Todd, 2021), `example`, have been simulated to reflect the AUTEK data discussed above. Raw Argos whale tracking data are available from the Dryad Digital Repository, see <https://doi.org/10.5061/dryad.dr7sqv9zb>, (Jones-Todd et al., 2021). The sonar data supporting this research are available from the Naval Undersea Warfare Center, and are not accessible to the public. To gain access please contact the Naval Undersea Warfare Center Division directly, <https://www.navsea.navy.mil/Home/Warfare-Centers/NUWC-Newport/Contact-Us/>.

References

- Jones-Todd, C. M. (2021). cmjt/mmre: Release for accepted manuscript. *Zenodo*. <https://doi.org/10.5281/zenodo.4876540>.
- Jones-Todd, C., Pirotta, E., Durban, J., Claridge, D., Baird, R., Falcone, E., Schorr, G., Watwood, S., and Thomas, L. (2021). Discrete-space continuous-time models of marine mammal exposure to Navy sonar (Version 3) [Data set]. *Dryad*, <https://doi.org/10.5061/DRYAD.DR7SQV9ZB>
- Kristensen, K., Nielsen, A., Berg, C. W., Skaug, H., and Bell, B. M. (2016). TMB: Automatic differentiation and Laplace approximation. *Journal of Statistical Software*, 70(5): 1–21.