Received: 4 March 2020 | Revised: 16 July 2020 | Accepted: 21 July 2020
DOI: 10.1111/1755-0998.13238

RESOURCE ARTICLE

MOLECULAR ECOLOGY RESOURCES WILEY

# Primers to highly conserved elements optimized for qPCR-based telomere length measurement in vertebrates

Stephanie F. Hudon[1] | Esteban Palencia Hurtado[2] | James D. Beck[3] | Steven J. Burden[1] | Devin P. Bendixsen[1] | Kathleen R. Callery[2] | Jennifer Sorensen Forbey[2] | Lisette P. Waits[4] | Robert A. Miller[5] | Ólafur K. Nielsen[6] | Julie A. Heath[2] | Eric J. Hayden[2]

[1]Biomolecular Sciences, Boise State University, Boise, ID, USA
[2]Department of Biological Sciences, Boise State University, Boise, ID, USA
[3]Computational Science and Engineering, Boise State University, Boise, ID, USA
[4]Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID, USA
[5]Intermountain Bird Observatory, Boise, ID, USA
[6]Department of Ecology, Icelandic Institute of Natural History, Garðabær, Iceland

**Correspondence**
Stephanie F. Hudon, Biomolecular Sciences, Boise State University, Boise, ID 83725, USA.
Email: stephaniehudon@boisestate.edu

**Funding information**
The authors acknowledge support from the National Science Foundation [OIA-1826801 to J.B., J.F. and E.H.; ECCS-1807809 to E.H. and S.B.], as well the Semiconductor Research Corporation [2018-SB-2842 to E.H. and S.B.] and by the National Aeronautics and Space Administration [80NSSC17K0738 to E.H.]. Additional

## Abstract

Telomere length dynamics are an established biomarker of health and ageing in animals. The study of telomeres in numerous species has been facilitated by methods to measure telomere length by real-time quantitative PCR (qPCR). In this method, telomere length is determined by quantifying the amount of telomeric DNA repeats in a sample and normalizing this to the total amount of genomic DNA. This normalization requires the development of genomic reference primers suitable for qPCR, which remains challenging in nonmodel organism with genomes that have not been sequenced. Here we report reference primers that can be used in qPCR to measure telomere lengths in any vertebrate species. We designed primer pairs to amplify genetic elements that are highly conserved between evolutionarily distant taxa and tested them in species that span the vertebrate tree of life. We report five primer pairs that meet the specificity and reproducibility standards of qPCR. In addition, we demonstrate an approach to choose the best primers for a given species by testing the primers on multiple individuals within a species and then applying an established computational tool. These reference primers can facilitate qPCR-based telomere length measurements in any vertebrate species of ecological or economic interest.