Replication of Figure 2: Time-varying interspecific interactions in a subset of the Maizuru fish community

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Ecological theory suggests that large-scale patterns such as community stability can be influenced by changes in interspecific interactions that arise from the behavioural and/or physiological responses of individual species varying over time. Although this theory has experimental support, evidence from natural ecosystems is lacking. Here, using tools for analysing nonlinear time series and a 12-year-long dataset of fortnightly collected observations on a natural marine fish community in Maizuru Bay, Japan, the authors show that short-term changes in interaction networks influence overall community dynamics.

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Keywords: Interaction networks; seasonal patterns; community dynamics

Highlights: Figure 2 shows that interactions in the Maizuru Bay fish community are not static; this contradicts a common assumption of ecological research. Instead, they change over time, as expected for a system with nonlinear dynamics. .

# 1 Introduction

The dynamics of ecological communities are influenced by interspecific interactions occurring at multiple temporal and spatial scales. Earlier studies have focused mainly on long-term effects.1–4 However, more recent theoretical and experimental studies have revealed that temporally variable ecological and/or biological responses (including physiological and behavioural responses) can have considerable effects on community dynamics.1,5 In this paper, they look instead at a measure that accounts for nonlinear dynamics and that tracks community stability as it varies through time. Relating fluctuating interaction networks to community stability is crucial for understanding how natural ecological communities are maintained.

This is a replication of figure 2A from6

# 2 Methods

Long-term time-series data of the fish community were obtained by underwater direct visual census conducted approximately once every two weeks along the coast of the Maizuru Fishery Research Station of Kyoto University (Nagahama, Maizuru: 35° 28′ N, 135° 22′ E) from 1 January 2002 to 2 April 2014 (285 time points during approximately 12 years). This high-frequency census enables the detection of short-term interspecific interactions.

## 2.1 Reproducibility

The data and code used in this analysis were packaged as a research compendium (R package rrtools).**marwickPackagingDataAnalytical2018?**,**rrtools2019?** The research compendium was written as an R package so other researchers can read, run, and modify the methods described here.

# 3 Results

## 3.1 Extract causality and interactions

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## 3.2 Figure 2

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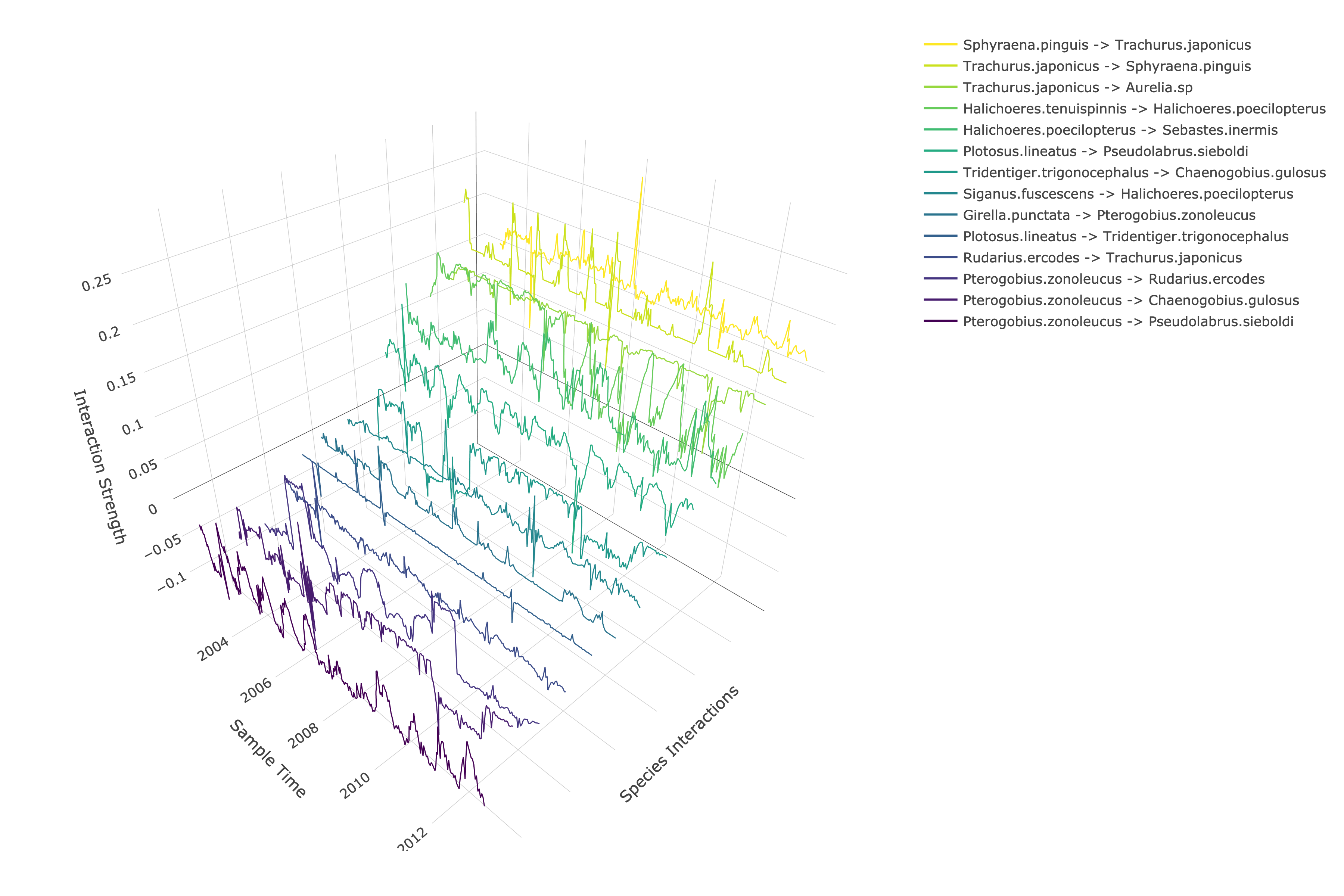


Figure 3.1: Time-varying interspecific interactions in a subset of the Maizuru fish community.

# 4 Conclusion

Here we present a framework based on attractor reconstruction from observational time series that quantifies the dynamic nature of the community interaction network and provides an estimate of dynamic stability. Although the exact individual-level behaviour that gives rise to the interspecific effect cannot be addressed by this analysis, the analysis does enable quantitative identification of the essential interactions that influence community dynamics. Further applications of this framework to ecological time series in different geographical regions—for example, Arctic and tropical regions3—will enable tests of the generality of the present results, and aid in identifying other critical patterns in the dynamic stability of natural ecological communities. Such applications of empirical dynamic modelling could also clarify the relationships between interaction strengths, properties of the distribution (for example, the dominance of weak interactions, skewness and standard deviations), network structure (for example, arrangements and topologies) and community dynamics (such as the relationship between dynamic stability and population variation observed in this study), enabling a more in-depth investigation of the mechanisms by which dynamic interactions and species diversity govern the behaviour of a wide range of natural ecosystems.

# 5 Acknowledgements

# 6 References

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### 6.0.1 Colophon

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