

# HOW TO WRITE A SCIENTIFIC ORIGINAL ARTICLE

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# WHAT IS A SCIENTIFIC PAPER?

- It is an addition to human knowledge;
- (addition of knowledge takes place through scientific papers)

## The purpose of your paper

- To convey your idea
- ...from your head to your reader's head
- Everything serves this single goal
- Conveying the idea
  - Here is a problem
  - It's an interesting problem
  - It's an unsolved problem
  - **Here is my idea**
  - My idea works (details, data)
  - Here's how my idea compares to other people's approaches

## Types of Articles

- Original article
- Review article
- Case report
- Letter to the editor
- Editorial Comment
- Etc....

## Contents of Original Article

- Title page
- Abstract
- Introduction
- Patients & Methods
- Results
- Discussion
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- Legends to Figures

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- Running title
- Key words
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- Corresponding author
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Ecology, 85(5), 2004, pp. 1273–1283  
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### COMPETITION BETWEEN NATIVE PERENNIAL AND EXOTIC ANNUAL GRASSES: IMPLICATIONS FOR AN HISTORICAL INVASION

JEFFREY D. CORBIN<sup>1,2</sup> AND CARLA M. D'ANTONIO<sup>1,2</sup>

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*Abstract.* Though established populations of invasive species can exert substantial competitive effects on native populations, exotic propagules may require disturbances that decrease competitive interference by resident species in order to become established. We compared the relative competitiveness of native perennial and exotic annual grasses in a California coastal prairie grassland to test whether the introduction of exotic propagules to coastal grasslands in the 19th century was likely to have been sufficient to shift community composition from native perennial to exotic annual grasses. Under experimental field conditions, we compared the aboveground productivity of native species alone to native species competing with exotics, and exotic species alone to exotic species competing with natives. Over the course of the four-year experiment, native grasses became increasingly dominant in the mixed assemblages containing natives and exotics. Although the competitive

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- Informative, specific, comprehensive, and accurate stating exactly what you mean
- Convey maximum information with minimum words
- Express (at least):
  - main issue of study
  - type of study

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## List of authors & institutions

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An author must have contributed something worthwhile:

- Creative thinking
- Performing essential diagnostic or therapeutic techniques
- Collecting data
- Analyzing data
- Writing

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## Authors

### Who should be first Author? (cont)

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- For multiple authors with various contributions:
  - done most work
- For multiple authors with equal contribution:
  - advantage to junior
  - junior first – senior last
- For 2 authors:
  - First publication: advantage junior

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### Who should be first Author? (cont)

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### Papers from Thesis

- A thesis is essentially a personal project
- Candidate's name should be first
- Most senior person last

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Be very careful to use only one name with the same spelling for all your publications.

Smith MA

Smith M

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- To be written in title page only
- Do not write institutions inside article
- Do not write information inside article that can identify authors' names

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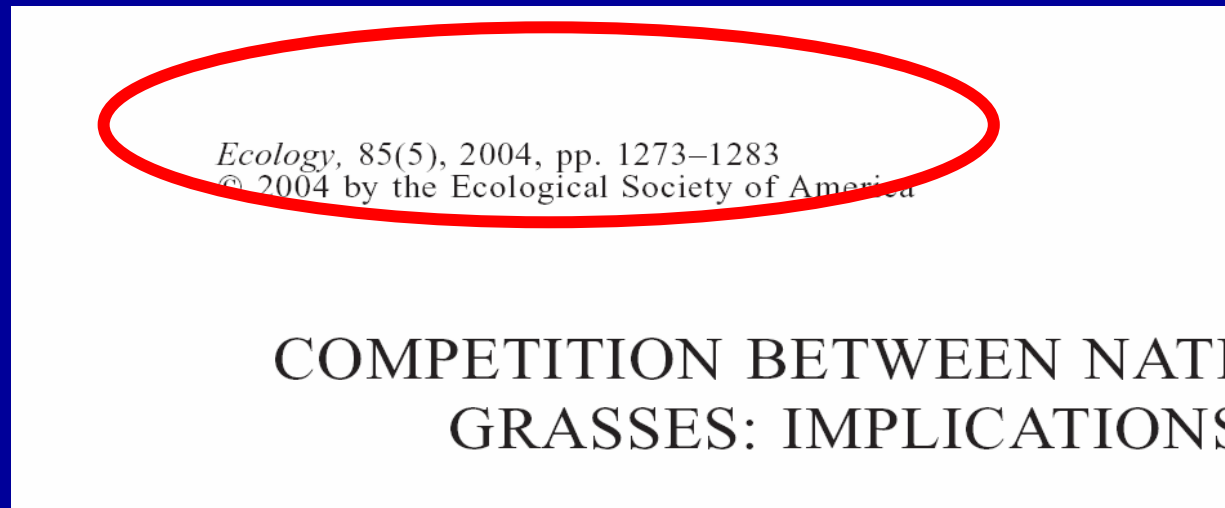
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- Journal title, volume (issue), page numbers, publisher



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## Keywords

Words that a search engine could pick up

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found evidence that the ability of established native perennial species to limit space available for exotic annual seeds to germinate and to limit the light available to exotic seedlings reduced exotic productivity and shifted competitive interactions in favor of the natives. If interactions between native perennial and exotic annual grasses follow a similar pattern in other coastal grassland habitats, then the introduction of exotic grass propagules alone without changes in land use or climate, or both, was likely insufficient to convert the region's grasslands.

*Key words:* California grassland; coastal prairie grassland; exotic annual grasses; grass competition; invasive species; native perennial grasses; priority effects.

### INTRODUCTION

Biotic invasions have been recognized as a major component of human-caused global change (Williamson 1996, Vitousek et al. 1997a), particularly in cases where invasions have resulted in the disruption of entire ecosystems by altering community composition, nutrient cycling rates, or disturbance regimes (Vitousek et al. 1987, 1997b, D'Antonio and Vitousek 1992). Considerable theoretical and experimental effort has been dedicated to identifying the factors that contribute to the success of exotic species in habitats where they have been introduced or are spreading (Reichard and

the exotic species to establish and spread is related to their ability to competitively suppress resident species (Levine et al. 2003). Invasions, however, are also known to be facilitated by disturbances that create gaps in vegetation cover such as grazing, gopher activity, or fires (Crawley 1987, Hobbs 1989, Hobbs and Huenneke 1992, Burke and Grime 1996). In these cases, exotic species may successfully establish only when disturbances decrease the competitive interference or priority effects (*sensu* Paine 1977) of resident vegetation. The degree to which the success of an invasion is explained by competitive superiority on the part of the exotic species vs. disturbances that allow exotics to become

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- Should include title only
- No authors names, no institutions
- This page will be used in review process

# Abstract

- Title page
  - Abstract**
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- First part to appear
  - Usually write abstract last
  - Used by program committee members to decide which papers to read
  - Contain 4 paragraphs carrying following titles:
    - *Objective*: aim of study
    - *Materials and methods*: most important data
    - *Results*: most important data
    - *Conclusions*:
      - All conclusions should be supported by study results
      - Common mistake: to write a conclusion based on previous studies and not supported by your own results
      - Your conclusions should perfectly satisfy study objectives
  - Word count: 200-300

# Introduction

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- Describe problem
- State your contributions
- Write list of contributions first
- List of contributions drives entire paper: paper confirms claims you have made
- Reader thinks “gosh, if they can really deliver this, that’s be exciting; I’d better read on

# Introduction

## Conveying idea

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- Concentrate single-mindedly on a narrative that:
  - describes problem, and why it is interesting
  - describes your idea
  - defends your idea, showing how it solves problem
- On the way, cite relevant work in passing, but defer discussion to end

# Introduction

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1. Short review of main subject of study
2. Problems, limitations and shortcomings of existing literature
3. Aim of study
4. Type of study

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### 1- Short Review

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- Should touch core of subject
- Should be concise and interesting, not boring
- Long historical reviews are dull
- Should be provided by some updated references
- It varies in length from one sentence to several paragraphs

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## 2- Limitations of existing literature

- Convince reader of importance of your study
- Give reasons for investigating this particular subject

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### 3- Aim of study

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- Study should answer an appropriate and important question
- Rationale of study must be strong and very clear
- There should be an addition to existing literature

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### 4- Type of Study

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- Set out scope of study
- Provide a quick overview of organization which follows

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## General Advice

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- Introduction must be short and to point
- It should be easy to read
- Do not use too many references (more suitable for discussion)

# Introduction

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- Broad information on topic
  - Previous research
- Narrower background information
  - Need for study
- Focus of paper
  - Hypothesis
- Summary of problem (selling point)
- Overall 300-500 words

# Introduction Evaluation

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Reviewer asks following questions:

- 1- Are objectives clear?
- 2- Is importance of study adequately emphasized?
- 3- Is subject matter of study new?
- 4- Is previous work on subject adequately cited?

# Materials and Methods

## Fundamental Parts

Provides instruction on exactly how to repeat experiment  
Should give a full description of:

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- Materials
  - *Example:* If patients:
    - Demographic characteristics
    - All relevant information
- Methods
  - *Example:*
    - Surgical technique
    - Radiological technique
    - Drug (preparation, dose, timing...etc)
- Type of study
  - *Example:*
    - Design Type of control
    - Randomization
- Statistical methods
  - Common: List
  - Uncommon: List + References

# Materials and Methods

## General Advice

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- Only new methods are described in details
- Previously published methods:
  - Common: Enumeration + reference
  - Uncommon: Short summary + reference.
- Do not lose your objective. All methods used should be devoted to satisfying objectives
- Ethical permission must be acknowledged in methods section

# Materials and Methods

## Statistical Issues

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### Give numbers of observations

- Sample size needed should be stated: useful to include a justification for number of subjects studied
- Basic observational units should be determined
- Proper method of analysis depends on basic observational units.
- Analysis of correlated observations raises difficult statistical analysis issues

# Materials and Methods

## Statistical Issues (cont)

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### Discuss eligibility of experimental subjects

- Reasons for and methods of selecting patients
- Some studies have eligibility criteria, eg: exclusion of patients outside a specified age range, those previously treated, and those too ill to answer questions, etc...
- Two major goals for reporting detailed ways of selection: 1) can be repeated by other investigators, 2) provides readers with a solid link between patients studied and population
- Eligibility constraints can introduce a sizable bias when results are generalized to population

# Materials and Methods

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### Give details about randomization

- Randomization enhances generalization of results and avoids biases
- Not sufficient to state that: "subjects were randomly selected," "random" often means "haphazard"

# Materials and Methods

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Describe methods for, and success of, any blinding of observations

- In studies involving comparisons between two treatments, most effective way to reduce bias on the part of both patient and physician is blinding
- Blinding is hiding of certain information from patients and physicians
- Because blinding can be applied in many different ways, researchers should state exactly “who was blinded to what”

# Materials and Methods

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### Report treatment complications

- Nearly every medical treatment carries some risk of complications, side – effects
- If no adverse effects can be found, report should say so and explain what was done to find them

# Materials and Methods

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Report losses to observation (dropouts from a clinical trial)

- Patients lost to follow-up, including losses or exclusions for noncompliance
- These patients might be different from others with respect to factors that might affect results
- Efforts to trace them should attempted
- Reasons for losses should be reported in details
- When sample size in text, table or graph differs from the original sample size, difference should be explained

# Materials and Methods

## Statistical Issues (cont)

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Use of statistics in medicine can be summarized as follows:

- 1) Statistics used to answer questions concerning differences,
- 2) Statistics used to answer questions concerning associations,
- 3) Statistics used to answer questions concerning predictions

# Materials and Methods

## Statistical Issues (cont)

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Researchers should always have a clear definition of their goal. Researchers have to choose between different measure and techniques:

- 1) Mean or median?
- 2) Normal or nonparametric distribution
- 3) Adjustments, matching or stratifications

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- Choice of statistical method depends on question raised and type of data collected
- Search for results that are “significant,” this leads to conclusions that may not hold if study is repeated, this called “Fishing expedition”

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- Authors should always report statistical methods used
- Authors should report positives and negatives of their study design
- Most statistical techniques depend on some assumptions, authors should indicate that these assumptions have been checked

# Materials and Methods

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Specify any general – use computer programs used

- Computer programs are sometimes found to have errors.
- Readers might wish to know about program used for their own use

# Materials and Methods Evaluation

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Reviewer asks following questions:

1. Is study population detailed adequately?
2. Are methods described well enough to reproduce experiment?
3. Is study design clear?
4. Are statistical methods included?

# Results

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### 1. Objective presentation of experiment

1. Present results as text, tables or graphs, but do not repeat same data in more than one.
2. The reader is entitled to have data presented in a logical order, which may not have been order in which work was done.

### 2. Interpretation

1. Associate your data with each others to obtain an objective proof of your hypothesis
2. In biological sciences, all measurements are inexact.
3. Only way to describe this variability is to use statistics intelligently

# Results

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- Do not write any result for a method not mentioned in section of materials and methods
- Results must be written in a very clear non- equivocal non-confusing manner
- Avoid redundancy (each information must be mentioned only once)
- Only relevant results (related to aim of study) should be mentioned
- Do not distract attention of reader by irrelevant results

# Results

## Statistical Issues

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### Clearly specify units of data

- Units should always be specified in text, tables, and figures. Is time months or years? Is quantities kilograms or grams ? Are rates per 10,000 or 100,000?
- Careful reporting of units prevents misunderstanding of results

# Results

## Statistical Issues (cont)

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When possible, quantify findings and present them with appropriate indicators of error or uncertainty

- Authors should use most appropriate measure that describes precisely their data, such as means and standard deviations as well as confidence intervals

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- Reporting test of significance (p-values) only, should be avoided
- Use standard deviation rather than standard error of mean. There are two reasons for this recommendations:
  - 1) standard error is a function of sample size,
  - 2) standard error pertains to groups, not individuals
- Exact P values should be reported
- Specify two-tail or one–tail tests

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## Statistical Issues (cont)

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Avoid sole reliance on statistical hypothesis testing such as use of P values which fails to convey important quantitative information

- Report both point estimates (means, proportions, or differences between means) and confidence intervals
- Confidence intervals provide information on magnitude of effect and how estimates would vary in other samples

# Results

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Avoid nontechnical uses of technical terms in statistics, such as “random” (which implies randomized device), “normal,” “significant,” “correlation,” and “sample”

- “Normal” refers to some kind of probability distribution, should not be confused with meaning of normal patient, that is free of disease
- “Significant” refers to result of a formal statistical test of significance
- “Correlation” is a technical word which refers to a specific method to measure association

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- All figures and tables must be referred to in text
- Figures and tables should be numbered in order they are cited in text

2). Plots containing natives (N and N + E plots) also had significantly lower dicot biomass removed during weeding as compared to E plots (Table 2).

did not differ between treatments (Fig. 4). Competition with exotic competitors had the least impact on *N. pulchra* of all the natives, though *N. pulchra* was consistently the smallest and least productive of the native perennial grasses (Figs. 3 and 4).

We also measured native performance using reproductive output and survival at the end of the third growing season, 2000–2001. Seed production by natives

# Results Evaluation

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Reviewer asks following questions:

1. Can reader assess results based on data provided?
2. Is information straightforward and not confusing?
3. Are there adequate controls?
4. Are statistical methods appropriate?

# Discussion

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### 1. Introduction

1. Start discussion by a small paragraph emphasizing importance of study

### 2. Discussion of result

1. Discuss your results in comparison with similar previous studies.
2. Give explanation for different results

### 3. New additions provided by your study

1. A separate paragraph must be written describing advantages and new additions provided

### 4. Limitations of your study

1. Disadvantages, limitations and short-comings of your study
2. How these could be avoided in future studies?

# Discussion

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- Do not discuss a previously discussed issue
- Avoid opinion bias. All important previous studies must be highlighted regardless their results (whether with or against your results)
- Interpret results
  - Did study confirm/deny hypothesis?
  - If not, did results provide an alternative hypothesis?  
What interpretation can be made?
  - Do results agree with other research? Sources of error/unusual data?
  - Implications of study for field
  - Suggestions for improvement and future research?

# Discussion Evaluation

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Reviewer asks following questions :

1. Do authors comment adequately on all their results?
2. Have authors explained why and how their study differs from others already published?
3. Do authors discuss potential problems and limitations with their study?
4. Are authors conclusions supported by results?

# Summary

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- Could be written as a separate section or as last paragraph of discussion
- Should stress on most relevant findings
- Take-home message
- A digest of whole study
- Not a repetition of abstract
- Justifies and explains conclusions

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- Each journal has its own style of references (house-style) explained in “instructions to authors.” Read instructions AND examine a recent copy of journal
- All references should be written in same style with same arrangement
- Recent references are better than old ones.
- A book reference is of least significant
- Some journals have a maximum number of references that should not be exceeded

# References Evaluation

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If you are lax with references you may have been  
lax with entire paper

# Tables

## Objectives

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- Pick-up content without reading text
- Reveal results at a glance

# Tables

## How to achieve a good table?

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- Data should be arranged in correct order
- Omit unimportant values
- Eliminate unnecessary words

# Tables

## Table vs. figure

What is more important to reader?

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General trend → Figure

Exact values → Table

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- To avoid redundancy, tables should provide additional information not present in text
- Tables should be carefully designed, simple, clear, not confusing and easy to follow
- Tables must be condensed, avoid splitting of data, all possible relevant information should be presented together in one table
- Tables comparing groups should contain their own statistical analysis
- If abbreviations are used, they should be explained at bottom of table, even if they were mentioned in text
- Tables are usually written after references in text, each table in a separate page, having its own number and title
- Be sure that correct number of table appears in correct place in text

# Figures & Illustrations

## Objectives

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- Not only to grasp message easily but also to hold it longer

“One picture is worth 1000 words”

- Not to beautify paper but to convey information:
  - introduce
  - explain
  - summarize

# Figures & Illustrations

## How to achieve a good illustration?

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- Simplicity is keynote of all arts
- Avoid sophistication and secondary details
- No repetition, no contradiction
- Consider good reproduction on photocopy

# Figures & Illustrations

## General advice

Title page

Abstract

Introduction

Materials &  
Method

Results

Discussion

Summary

References

Tables

**Figures**

Legends to  
Figures

- Back of each figure should be identified by its number on top
- Be sure that correct number of figure appears in correct place in text

# Legends to Figures & Illustrations

## General advice (cont)

Title page

Abstract

Introduction

Materials &  
Method

Results

Discussion

Summary

References

Tables

Figures

**Legends to  
Figures**

- Legends of all figures are written in a separate page usually after tables
- Do not write legend above or below figure
- Legends should be complementary to text, not repetitive
- Do not distract reader too long away from text by writing too long legend

## Conclusion, Summary & Abstract

**Conclusion:** Very few sentences expressing study message

**Summary:** An extended conclusion  
Justifies and explains conclusion

**Abstract:** Contains most important ideas

Structured as:

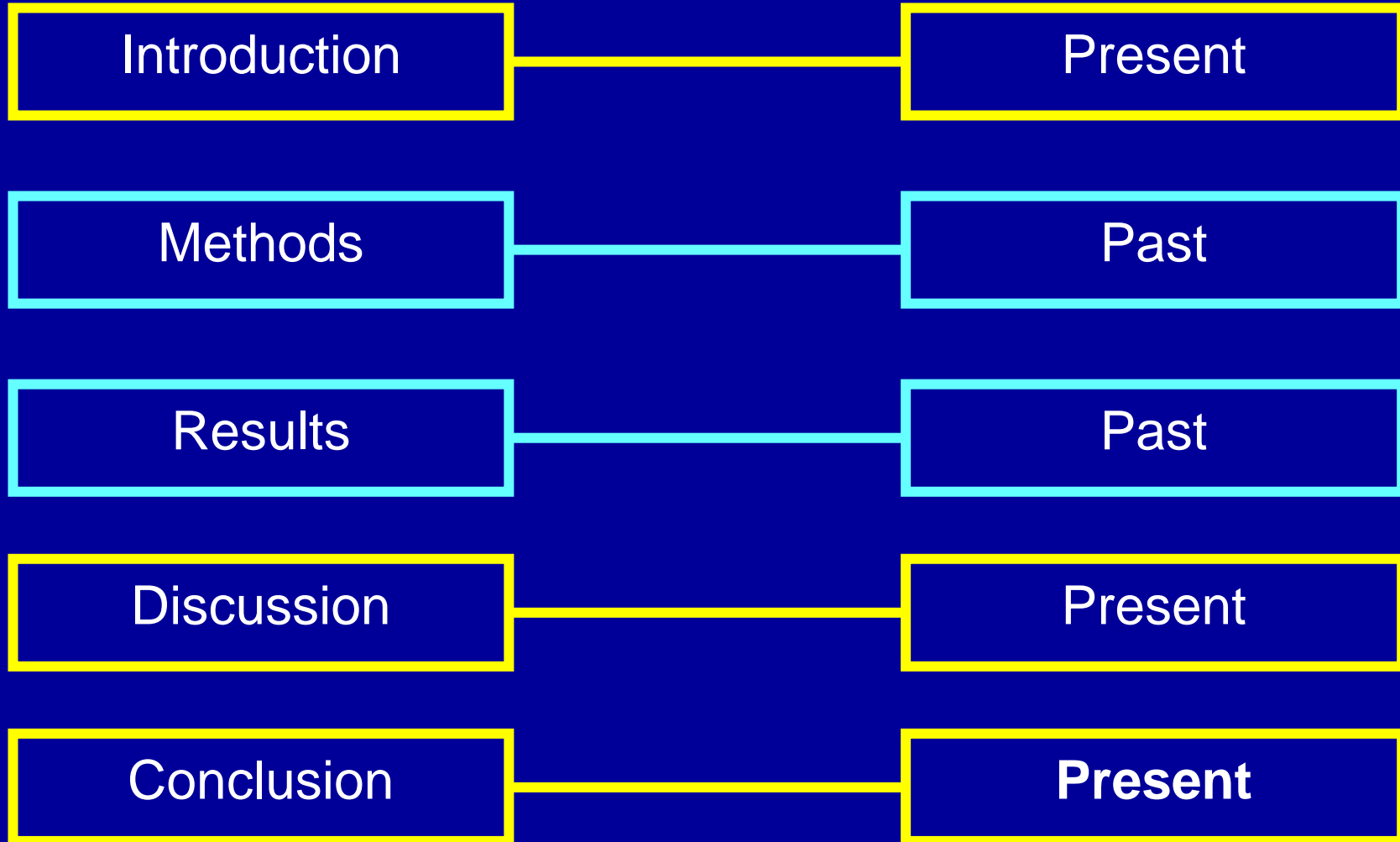
objectives,

methods,

results

and conclusion

# Verb Tenses



## Common Reasons for Rejection

- Study did not address an important scientific issue
- Study was not original (someone else had already done same or a similar study)
- Article not relevant to journal
- Paper is not styled for journal
- Study did not actually test authors' hypothesis, a different type of study should have been done
- Practical difficulties (in recruiting subjects, for example) led authors to compromise on original study protocol

## Common Reasons for Rejection (Cont)

Sample size was too small

Study was uncontrolled or inadequately controlled

Statistical analysis was incorrect or inappropriate

Authors drew unjustified conclusions from their data

There is a significant conflict of interest (one of authors, or a sponsor, might benefit financially from publication of paper and insufficient safeguards were seen to be in place to guard against bias)

Paper is so badly written that it is incomprehensible