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To cite this article: Edy Budiman *et al* 2019 *J. Phys.: Conf. Ser.* **1230** 012011

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# Web Performance Optimization Techniques for Biodiversity Resource Portal

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**Abstract.** Monitoring and evaluation is a part of management that must be done if want to an increase, and improvement in performance. Therefore, these activities are needed as an effort to develop, manage and optimize the Biodiversity Resource Portal. This study aims to analyze the efficiency of the Biodiversity resource portal of the key performance indicators on Image and script (CSS / JScript) content. Pre-Test and Post-Test analysis methods using Web Performance Optimization Techniques. Evaluation the test results showed an increase in end-to-end web performance after optimization, from the efficiency score of pretest Grade F (13%) to Grade B (82%) post-test.

## 1. Introduction

Web performance will affect revenue and web page rank. In addition, performance also affects the level of success at Web Performance Optimization (WPO) [1]. WPO is a knowledge of improving the performance of website pages. WPO looks at page components such as content, image, presentation components, a script (CSS/JScript), page elements, page assets and the like. In addition, WPO involves and provides techniques, best practices, best rules, and methodologies for end-to-end web performance optimization. The requirements for website evaluation arise from the definition of that: a general evaluation of all the characteristics of the website, and how well the site meets specific needs. The quality of the website also relates to criteria such as timeliness, ease of navigation, ease of access and presentation of information.

Biodiversity Information System as an example of an information system that presents taxonomic data, forming an ontology model that can present, map data as information about data descriptions and the relationship between taxonomy of diversity data based on taxonomic levels based on data stored in the database [2-4]. The database relational object in its application requires several steps or processes for its implementation. Biodiversity Information System (BIS) as one of the web portals for developing the system contains many biodiversity data resources. Biological diversity according to [5] refers to the variety and variability among living organisms and the ecological complexes in which they occur. Information on biodiversity requires a combination of data about living things and their habitat, building a model that connects all kinds of information. Data is handled heterogeneously, which is provided and distributed by different research groups, which collect data using different vocabulary, nomenclature and scientific names. The biodiversity portal has an important role in the effort to profile information literacy so that it is better known in the community. That is why optimizing website performance for existing data resources is a must. It is important that special handling techniques are needed to make the website easier in accessing data, indexing, and



understanding website content. Therefore, a good and quality website is needed. So that it can provide usability according to the purpose of making a biodiversity resource portal.

Previous research such as i.e. Samad H, et. al [6] on Performance Request Evaluation of Web Application based on Request Bit per Second and Transfer Rate Parameters. Research by Sbayti, M., et. al. [7] about Optimization techniques applied to single point incremental forming process for biomedical application. The research [8-17], this study conducted a survey of tools, techniques, methodologies, various aspects of web performance optimization. In addition, there is also research analysing the websites of universities in India, which according to [18] this quality assurance of a website depends on Automation testing tools that reduce costs and improve efficiency. The performance of a website can be an important factor for its success. Success depends on the main speed factor. If the speed of the website is fast then the automatic performance increases, therefore, performance can be evaluated using a tool that gives details of resources and components on the website.

This study discusses the quality of efficiency of the Biodiversity Resource Portal, and analyses Web performance Optimization. The object of the research is the web Portal Borneo Biodiversity Information System (BBIS) [19], an information system for Biodiversity of Kalimantan, Indonesia, which was developed by an informatics research laboratory at the Faculty of Computer Science and Information Technology, Mulawarman University [20], [21]. The optimization method uses the Web Performance Optimization Technique, with a series of Pre-Test and Post-Test Tests on Portal Pages on the main performance indicators of web content Images and Scripts.

## 2. Optimization Techniques and Methodology

### 2.1. Web Performance Optimization Techniques

The testing approach method to the resource biodiversity portal website uses Web Performance Optimization (WPO) techniques to assess the quality of the efficiency characteristics of the biodiversity information system website and web server. System performance data analysis focuses on the variable speed of web access based on recommendations from Google PageSpeed [22] and YSlow Yahoo Developer [23]. The tools used in doing website optimization are using GTmetrix [24]. GTmetrix is a tool developed by GT.net, to see website performance, check the speed of a website that is a combination of Google *PageSpeed* Insights and *YSlow* to generate value and recommendations.

The test scenario is divided into 2 parts:

- Preliminary Testing (Pre-Test)

A pre-test is a test of the main web portal page as the initial condition of website performance before optimization. The results of the Pre-Test test are then optimized.

- Test Optimization (Post-Test)

Post-Test is a test of the main web portal page after using Web Performance Optimization (WPO) Techniques. The results of the Post-Test are the final results of the use of the technique used (WPO).

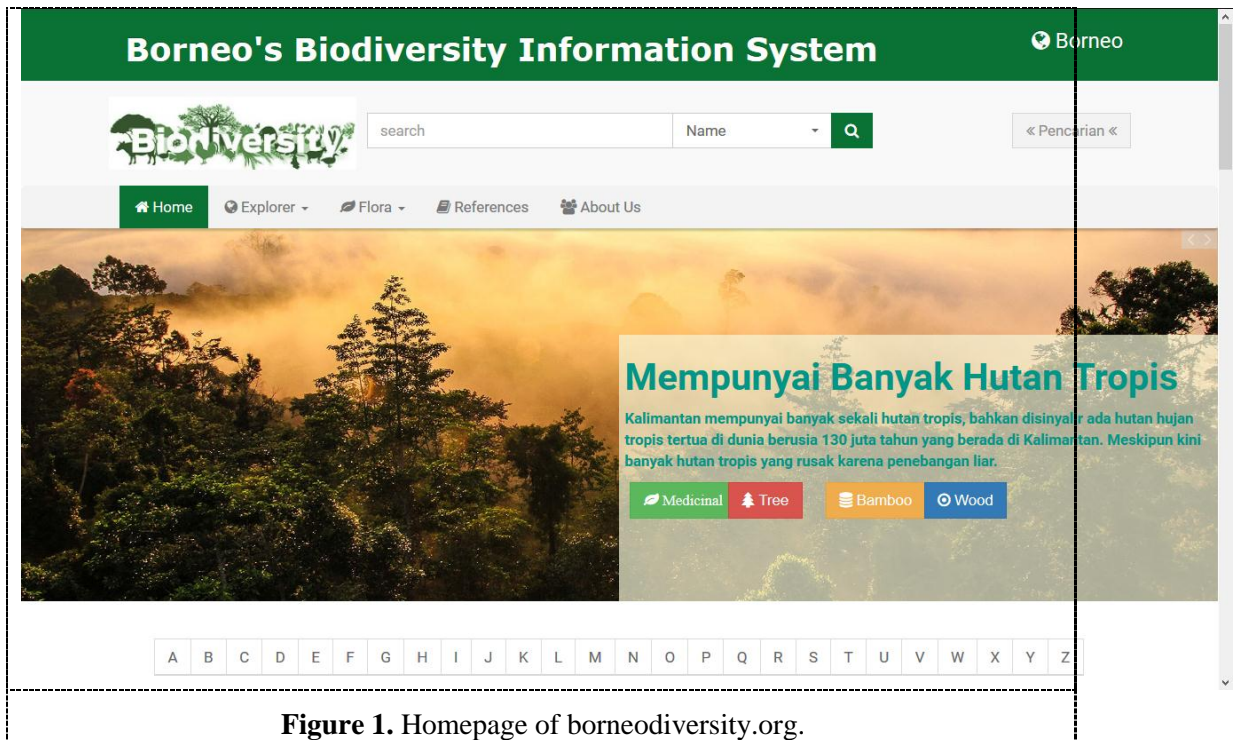
Methods of evaluating Grade and Scores rating for efficiency performance analysis using evaluation parameters from [23], shown in Table 1.

**Table 1.** Grade and Score for analysis of efficiency performance [23].

Score	Grade
A	$90 \leq S \leq 100$
B	$80 \leq S < 90$
C	$70 \leq S < 80$
D	$60 \leq S < 70$
E	$50 \leq S < 60$
F	$0 \leq S < 50$

## 2.2. Biodiversity Resource Portal

Web Portal Borneo Biodiversity Information System (BBIS) as the object of research, online at the website URL: <http://borneodiversity.org/index>. The screenshots of the system website interface are seen in Figure 1.



**Figure 1.** Homepage of borneodiversity.org.

The Web Portal of Borneo's biodiversity information system was developed using the Model-view-controller design pattern based on the Laravel Framework. Content resource capacity on the BBIS system has now stored data and information with visual images of 1482 records the Tree data, 233 records plant medicinal, 86 records of Wood data, and 80 records Bamboo data.

## 3. Results Analysis and Discussion

### 3.1. Pre-Test Results

The initial testing is done by entering the portal system address on the Dashboard on the GTmetrix homepage. Figure 2 shows the results of testing a website with GTmetrix.



**Figure 2.** Pre-test Performance Results (Score and score).

The results of the Preliminary Test (Pre-Test) presented in Figure 2, show the performance of the BBIS Portal web page in category Grade F with a score of 13% for rating PageSpeed Google, and Grade D (69%) for rating from YSlow Yahoo.

The results of the analysis of resource recommendations in detail are presented in Figure 3.

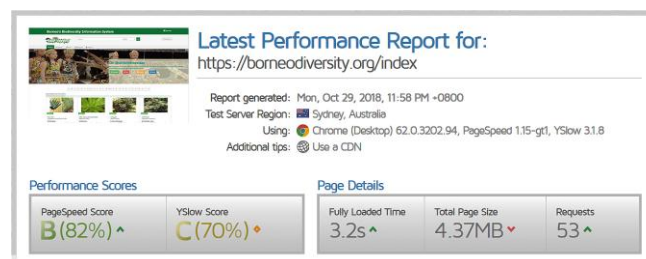
RECOMMENDATION	GRADE	TYPE	PRIORITY
▼ <b>Serve scaled images</b>	Pre-Test F (0)	IMAGES	HIGH
▼ <b>Optimize images</b>	Pre-Test F (0)	IMAGES	HIGH
▼ <b>Minify JavaScript</b>	Pre-Test E (52)	JS	HIGH
▼ <b>Combine images using CSS sprites</b>	A (100)	IMAGES	HIGH
▼ <b>Avoid CSS @import</b>	A (100)	CSS	MEDIUM
▼ <b>Prefer asynchronous resources</b>	A (100)	JS	MEDIUM
▼ <b>Inline small CSS</b>	A (100)	CSS	HIGH
▼ <b>Inline small JavaScript</b>	A (100)	JS	HIGH
▼ <b>Optimize the order of styles and scripts</b>	A (100)	CSS/JS	HIGH
▼ <b>Put CSS in the document head</b>	A (100)	CSS	HIGH
▼ <b>Specify image dimensions</b>	A (99)	IMAGES	MEDIUM

**Figure 3.** Detailed Analysis of Pre-test Performance Results (PageSpeed Recommendation).

Detailed Analysis of Performance Results Pre-tests for PageSpeed Recommendations in Figure 3, show that there are resources for web content that gets Grade and low scores, namely on the problem of recommendations on the type of images content: "Server scale images" with Grade F (0%), Image Optimize Grade F (0%) and content type JS "Minify JavaScript" with Grade E (52%).

**3.2. Optimization Results (Post-Test)**

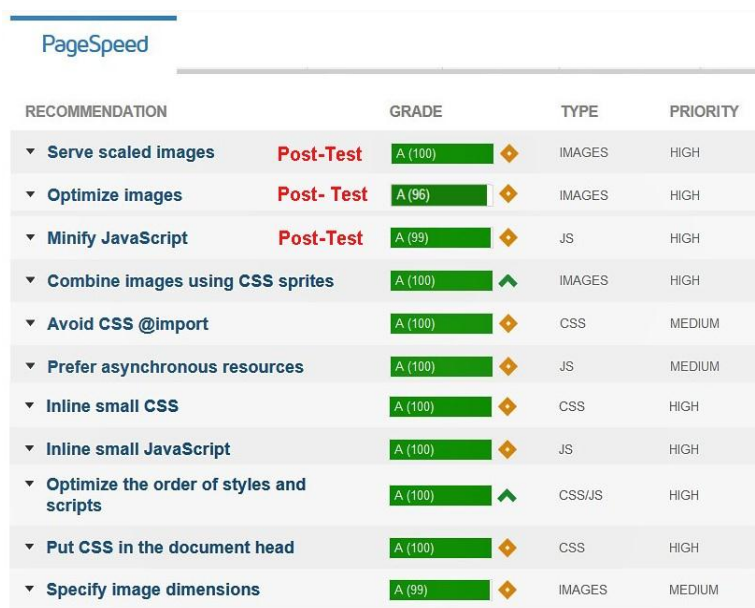
Post-Test for Web performance optimization focuses on Google's PageSpeed recommendations. Assessment results The optimization test (Post-Test) presented in Figure 4 shows the improvement in the performance of the BBIS Portal Page by obtaining a Grade B category with a score of 82% for ratings from Google PageSpeed, and Grade C (70%).



**Figure 4.** Optimization (Post-test) Performance Results.

Detailed results analysis Test optimization (Post-Test) in Figure 4 and Figure 5 explains an increase in web performance from Grade F (13%) to Grade B (82%). This shows that there was an increase in the percentage of performance by 69% (Resource Optimization by 69%). Optimization results of "Serve scaled images" recommendations with Grade A (100%), "Optimize images" Grade A (96%) and content type JS "Minify JavaScript" with Grade A (99%).





The image shows a screenshot of the PageSpeed Recommendations table. The table has four columns: RECOMMENDATION, GRADE, TYPE, and PRIORITY. Each row represents a recommendation with a corresponding grade, type, and priority. The 'Post-Test' status is highlighted in red for the first three recommendations.

RECOMMENDATION	GRADE	TYPE	PRIORITY
▼ <b>Serve scaled images</b>	<b>Post-Test</b> A (100)	IMAGES	HIGH
▼ <b>Optimize images</b>	<b>Post-Test</b> A (96)	IMAGES	HIGH
▼ <b>Minify JavaScript</b>	<b>Post-Test</b> A (99)	JS	HIGH
▼ <b>Combine images using CSS sprites</b>	A (100)	IMAGES	HIGH
▼ <b>Avoid CSS @import</b>	A (100)	CSS	MEDIUM
▼ <b>Prefer asynchronous resources</b>	A (100)	JS	MEDIUM
▼ <b>Inline small CSS</b>	A (100)	CSS	HIGH
▼ <b>Inline small JavaScript</b>	A (100)	JS	HIGH
▼ <b>Optimize the order of styles and scripts</b>	A (100)	CSS/JS	HIGH
▼ <b>Put CSS in the document head</b>	A (100)	CSS	HIGH
▼ <b>Specify image dimensions</b>	A (99)	IMAGES	MEDIUM

**Figure 5.** Detailed Analysis of Optimization Testing (Post-test) Performance Results (PageSpeed Recommendation).

### 3.3. Evaluation of Web Performance Optimization Techniques Utilization

Utilization of Web Performance Optimization Techniques for Biodiversity Portal using the GTmetrix tool explains that web portal resources Based on the recommendations from the Pre-test performance testing tool, it is known that the resources in the image and script content on the BBIS web portal are presented in Table 2, showing that web resources related to the problem Optimize image and Serve Scaled Images affect web performance, causing the system in each access to loading web pages to be slow because of the large file size and dimensions of the images scale.

**Table 2.** Performance Score of *PageSpeed* Recommendations for Optimization.

Recommendation	Grade Score for Pre-Test	Grade Score for Post-Test	Type	Resized in HTML or CSS from Image Scale
Serve scaled images	F (0)	A (100)	images	Serving scaled images could save 3.3MiB (77% reduction)
Optimize images	F (0)	A (96)	images	Optimize the following images to reduce their size by 965.0KiB (12% reduction).
Minify JavaScript	E (52)	A (99)	JS	Minify JavaScript for the following resources to reduce their size by 58.4KiB (31% reduction).

The recommendations presented in Table 2 are priority recommendations for improving the quality of the web portal Borneo Biodiversity Information System. The recommendations from the Pre-Test were optimized by improving/repared the content so that the results of the Post-test gave better performance than the Pre-Test.

Evaluate web resources to improve and optimize the performance of the website's BBIS:

- Improve Portal Performance - *Optimize and Serve Scaled Images*

Image optimization aims to reduce image size without sacrificing image quality. Must find a balanced way between reducing size and maintaining image quality. The two selected types of images are JPEG

and PNG. JPEG format is usually used in pictures. This is because: It has a smaller overall image size, good image quality, can be resized or compressed without reducing image quality. Compress the image in balance. This means that the quality and size must be the same and not biased. If the image fails or forgets to be optimized, website speed will decrease and excessive bandwidth usage. That image "confiscates" some space, and most space is not needed.

- Improve Portal Performance - *Minify JavaScript*

Minify is a programming term which means the process of removing unneeded characters in the code to be executed. Minimizing the code will speed up the loading speed of the portal, the effect. In short, this process will delete all space characters, new lines, comments, and restrictions from the code. This type of character is used so that your code can be read easily, but it is actually not needed and is not executed by the code. So, this small process can increase download speed, parsing, and portal execution time.

#### 4. Conclusion

Resource performance evaluation of the Borneo's Biodiversity Information System portal using the Web Performance Optimization (WPO) technique. The comparison of optimization results Pre-test and post-test shows that there is a significant influence on WPO techniques to improve portal resource performance. There are three recommendations optimized, i.e. "*Serve Scale Image, Image Optimization, and Minify JavaScript*". These three recommendations are influenced by issues of size and scale of resources in the content of image files and website builder scripts.

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### Acknowledgments

Acknowledgments to the **Directorate General of Strengthening for Research and Development - Ministry of Research, Technology and Higher Education** of the Republic of Indonesia who have given "financial support" to this research. Thanks also to the Institute Research and Community Service (*Lembaga Penelitian dan Pengabdian Masyarakat: LPPM*) Mulawarman University for all the support and mentoring assistance during this research.