

## An Introduction to Behavioural Ecology, 4th Edition

Nicholas B. Davies, John R. Krebs, Stuart A. West



WILEY-BLACKWELL

# Effects of River Impoundment on Ecosystem Services of Large Tropical Rivers: Embodied Energy and Market Value of Artisanal Fisheries

1. DAVID J. HOEINGHAUS<sup>1,\*</sup>,
2. ANGELO A. AGOSTINHO<sup>2</sup>,
3. LUIZ C. GOMES<sup>2</sup>,
4. FERNANDO M. PELICICE<sup>2,\*</sup>,
5. EDSON K. OKADA<sup>2</sup>,
6. JOÃO D. LATINI<sup>2</sup>,
7. ELAINE A. L. KASHIWAQUI<sup>2,\*</sup>,
8. KIRK O. WINEMILLER<sup>1</sup>

Article first published online: 18 MAY 2009

DOI: 10.1111/j.1523-1739.2009.01248.x

©2009 Society for Conservation Biology

Issue



## Conservation Biology

Volume 23, Issue 5, ([doi/10.1111/cbi.2009.23.issue-5/issuetoc](https://doi.org/10.1111/cbi.2009.23.issue-5/issuetoc)) pages 1222–1231, October 2009

Additional Information

### How to Cite

HOEINGHAUS, D. J., AGOSTINHO, A. A., GOMES, L. C., PELICICE, F. M., OKADA, E. K.,

LATINI, J. D., KASHIWAQUI, E. A. L. and WINEMILLER, K. O. (2009), Effects of River Impoundment on Ecosystem Services of Large Tropical Rivers: Embodied Energy and Market Value of Artisanal Fisheries. *Conservation Biology*, 23: 1222–1231. doi: 10.1111/j.1523-1739.2009.01248.x

## Author Information

1 Section of Ecology, Evolutionary Biology and Systematics, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258, U.S.A.

2 Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura (Nupelia), Universidade Estadual de Maringá, Maringá, Paraná 87020-900, Brasil

\* ‡Current address: Department of Biological Sciences and the Institute of Applied Science, University of North Texas, 1155 Union Circle #310559, Denton, Texas 76203-5017, U.S.A., email [djhoeing@ksu.edu](mailto:djhoeing@ksu.edu) (<mailto:djhoeing@ksu.edu>)

§Current address: Núcleo de Estudos Ambientais (Neamb), Universidade Federal do Tocantins, Porto Nacional, Tocantins 77500-000, Brasil

\*\*Current address: Universidade Estadual de Mato Grosso do Sul, Unidade de Mundo Novo, Mato Grosso do Sul 79980-000, Brasil

## Publication History

1. Issue published online: 14 SEP 2009
2. Article first published online: 18 MAY 2009
3. Paper submitted June 16, 2008; revised manuscript accepted February 4, 2009.

- Abstract
- [Article \(/doi/10.1111/j.1523-1739.2009.01248.x/full\)](https://doi.org/10.1111/j.1523-1739.2009.01248.x/full)
- [References \(/doi/10.1111/j.1523-1739.2009.01248.x/references\)](https://doi.org/10.1111/j.1523-1739.2009.01248.x/references)
- [Cited By \(/doi/10.1111/j.1523-1739.2009.01248.x/citedby\)](https://doi.org/10.1111/j.1523-1739.2009.01248.x/citedby)

[View Full Article \(HTML\) \(/doi/10.1111/j.1523-1739.2009.01248.x/full\)](https://doi.org/10.1111/j.1523-1739.2009.01248.x/full) [Get PDF \(474K\) \(/doi/10.1111/j.1523-1739.2009.01248.x/pdf\)](https://doi.org/10.1111/j.1523-1739.2009.01248.x/pdf)

## Keywords:

ecological economics; ecosystem services; energy; food webs; Itaipu Reservoir; sustainability; tropical

Alto Paraná; economía ecológica; energía; posición trófica; redes tróficas; servicios del ecosistema; sustentabilidad

**Abstract:** *Applying the ecosystem services concept to conservation initiatives or in managing ecosystem services requires understanding how environmental impacts affect the ecology of key species or functional groups providing the services. We examined effects of river impoundments, one of the leading threats to freshwater biodiversity, on an important ecosystem service provided by large tropical rivers (i.e., artisanal fisheries). The societal and economic importance of this ecosystem service in developing countries may provide leverage to advance conservation agendas where future impoundments are being considered. We assessed impoundment effects on the energetic costs of fisheries production (embodied*

energy) and commercial market value of the artisanal fishery of the Paraná River, Brazil, before and after formation of Itaipu Reservoir. High-value migratory species that dominated the fishery before the impoundment was built constituted a minor component of the contemporary fishery that is based heavily on reservoir-adapted introduced species. Cascading effects of river impoundment resulted in a mismatch between embodied energy and market value: energetic costs of fisheries production increased, whereas market value decreased. This was partially attributable to changes in species functional composition but also strongly linked to species identities that affected market value as a result of consumer preferences even when species were functionally similar. Similar trends are expected in other large tropical rivers following impoundment. In addition to identifying consequences of a common anthropogenic impact on an important ecosystem service, our assessment provides insight into the sustainability of fisheries production in tropical rivers and priorities for regional biodiversity conservation.

**Resumen:** *La aplicación del concepto de servicios del ecosistema a iniciativas de conservación o al manejo de servicios del ecosistema requiere del entendimiento del efecto de los impactos ambientales sobre la ecología de especies clave o grupos funcionales que proporcionan los servicios. Examinamos los efectos de los reservorios en ríos, una de las principales amenazas a la biodiversidad dulceacuícola, sobre un importante servicio del ecosistema proporcionado por ríos tropicales (i.e., pesquerías artesanales). La importancia social y económica de este servicio del ecosistema en países en desarrollo puede proporcionar impulso para avanzar en las agendas de conservación donde se están considerando represas en el futuro. Evaluamos los efectos de las represas sobre los costos energéticos de la producción de pesquerías (energía virtual) y el valor de mercado comercial de la pesquería artesanal del Río Paraná, Brasil, antes y después de la formación de la Represa Itaipu. Las especies migratorias de alto valor que dominaban la pesquería antes de que se construyera la represa constituían un componente menor de la pesquería contemporánea que se basa fundamentalmente en especies introducidas adaptadas a la represa. Los efectos en cascada de la represa resultaron en una incompatibilidad entre la energía virtual y el valor de mercado: los costos energéticos de la producción de pesquerías incrementaron mientras que el valor de mercado decrecía. Esto se debió parcialmente a cambios en la composición funcional de especies, pero también estuvo ligado estrechamente a las identidades de las especies que afectaron el valor de mercado como un resultado de las preferencias de los consumidores aun cuando las especies eran similares funcionalmente. Se esperan tendencias similares en otros ríos tropicales después de la construcción de represas. Adicionalmente a la identificación de consecuencias de un impacto antropogénico común sobre un importante servicio del ecosistema, nuestra evaluación ofrece una visión reveladora de la sustentabilidad de la producción de pesquerías en ríos tropicales y permite priorizar la conservación de la biodiversidad regional.*

[View Full Article \(HTML\) \(/doi/10.1111/j.1523-1739.2009.01248.x/full\)](http://doi/10.1111/j.1523-1739.2009.01248.x/full) [Get PDF \(474K\) \(/doi/10.1111/j.1523-1739.2009.01248.x/pdf\)](http://doi/10.1111/j.1523-1739.2009.01248.x/pdf)

## More content like this

Find more content:

- [like this article \(/advanced/search/results?articleDoi=10.1111/j.1523-1739.2009.01248.x&scope=allContent&start=1&resultsPerPage=20\)](/advanced/search/results?articleDoi=10.1111/j.1523-1739.2009.01248.x&scope=allContent&start=1&resultsPerPage=20)

Find more content written by:

- [DAVID J. HOEINGHAUS \(/advanced/search/results?searchRowCriteria\[0\].queryString="DAVID J. HOEINGHAUS"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [ANGELO A. AGOSTINHO \(/advanced/search/results?searchRowCriteria\[0\].queryString="ANGELO A. AGOSTINHO"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [LUIZ C. GOMES \(/advanced/search/results?searchRowCriteria\[0\].queryString="LUIZ C. GOMES"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [FERNANDO M. PELICICE \(/advanced/search/results?searchRowCriteria\[0\].queryString="FERNANDO M. PELICICE"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [EDSON K. OKADA \(/advanced/search/results?searchRowCriteria\[0\].queryString="EDSON K. OKADA"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [JOÃO D. LATINI \(/advanced/search/results?searchRowCriteria\[0\].queryString="JO%C3%83O D. LATINI"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [ELAINE A. L. KASHIWAQUI \(/advanced/search/results?searchRowCriteria\[0\].queryString="ELAINE A. L. KASHIWAQUI"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [KIRK O. WINEMILLER \(/advanced/search/results?searchRowCriteria\[0\].queryString="KIRK O. WINEMILLER"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)
- [All Authors \(/advanced/search/results?searchRowCriteria\[0\].queryString="DAVID J. HOEINGHAUS" "ANGELO A. AGOSTINHO" "LUIZ C. GOMES" "FERNANDO M. PELICICE" "EDSON K. OKADA" "JO%C3%83O D. LATINI" "ELAINE A. L. KASHIWAQUI" "KIRK O. WINEMILLER"&searchRowCriteria\[0\].fieldName=author&start=1&resultsPerPage=20\)](/advanced/search/results?searchRowCriteria[0].queryString=\)