SYLLABUS
Summer 2018

COURSE NAME & NUMBER	***Tropical Restoration Ecology*** (ENVM 625-01) Summer Session 2
CLASS TIME	June 16 through July 1, 2018
MEETING LOCATION	TBD for Pre-Field and Post-Field Classes. See Field Course Location Description below.
CREDIT HOURS	Students receive 2 units for participating in and completing the 2 week field course. They may receive 4 units if they work on a long-term restoration planing effort with Kopel and USF Instructor in the remaining Summer 2018 semester and/or help with soil sampling monitoring and training at Kopel before the class.
PREREQUISITE	ENVM 602 OR ENVS 210 OR BIO 319

COURSE DESCRIPTION

This field course is designed for both graduate and undergraduate students to learn about the practice of Ecological Restoration as well as the science of Restoration Ecology through hands on experience in restoring habitat for endangered wildlife in tropical rainforests and riparian ecosystems. Emphasis is placed on the application of ecological principles to restoration design, implementation, and monitoring. Major course topics will include: soils, vegetation, and hydrology sampling at restoration sites; restoration for wildlife habitat; invasive species management; data collection from and using reference sites as models; and monitoring and assessment of restoration projects. The class will take place in Malaysian Borneo along the lower Kinabatangan River at the Tungog Rainforest Eco Camp (TREC) managed by KOPEL. KOPEL is a Community-based organization, protecting rainforest ecosystems, wildlife and biodiversity of the Lower Kinabatangan while preserving the livelihood of the local population. They have conducted rainforest and riparian habitat restoration since 1999, pioneering novel techniques and planting nearly 100,000 trees in various habitats. In this class, we will help KOPEL develop their long-term restoration and monitoring plan using landscape perspective for wildlife corridors and integrating all of their efforts. At TREC, we will also learn about sustainability practices used at this Eco Camp. More information about this grassroots village coop organization and their restoration and conservation activities can be found at http://www.mescot.org

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OFFICE HOURS	by appointment

FIELD LOCATION

The Kinabatangan River flows for 560km out of the mountainous interior of the Island of Borneo to the northeast coast in the Malaysian State of Sabah. Most of its upper reaches are primary growth rainforest teaming with wildlife and nearly untouched by human development. The Lower Kinabatangan meanders through a very large floodplain, the habitat that has been impacted by logging, agriculture, and the palm oil industry. This is the area that KOPEL is working to restore. Rainforests along the floodplain of the Kinabatangan River have some of the highest botanical diversity in Southeast Asia and an astounding array of wildlife species still able to survival in the ever changing landscape. Wildlife can be easily seen from the River by boat including: Orangutan, Long-tailed Macaques, Proboscis Monkeys, several species of Hornbill, Crocodiles, and occasionally Elephants. On day and night hikes one can observe several species of civet cat, bearded pig, clouded leopard, and other unique tropical birds.

We will travel to and explore primary growth rainforest and mangrove ecosystems around Sepilok during the first weekend. We will also visit the Sabah Forestry Department Research Center at Sepilok which houses Southeast Asia's largest herbarium, largest insect collection, wood sciences collection (xylarium), seed banks, agroforestry and plantation forestry operation, tissue culture labs, and a large nursery. Around Sepilok, we will also visit the Rainforest Discovery Centre (RDC) with canopy walks, the Orangutan Rehabilitation Centre, and Sun Bear Conservation Centre.

LEARNING GOALS AND OBJECTIVES, AND LEARNING OUTCOMES

At the end of this course, students should understand ecological concepts supporting the science of restoration ecology, as well as the practice of ecological restoration, including the implementation and management of restoration projects. After completing this course, students should be able to:

- understand the importance of plant ecology, soil science, hydrology and wildlife habitat requirements to successful ecosystem restoration;
- be familiar with the restoration planning and design process;
- analyze restoration ecology resources, such as soil maps, historical aerial photos, etc.;
- collect, interpret, and clearly present ecological data from a reference and restoration site using various observation, visualization and instrumentation sampling methods;
- continue development of the restoration monitoring plan with Kopel based on restoration ecology principles and reference site data collected in the last two years; and
- understand how effective community-based restoration works.

REFERENCE MATERIALS

A series of readings are available on the course Canvas site and in a course reader that will be handed out at the first pre-field class. A series of readings and reading quiz will be completed prior to the beginning of the field class. Additional readings will be assigned for students taking the 4-unit option after the field class.

TEXTBOOK

Phillipps, Q. and K. Phillipps. 2016. Phillipps' Field Guide to the Mammals of Borneo and their Ecology. Natural History Publication (Borneo), Kota Kinabalu. (approximately $30)

INSTRUCTIONAL STRATEGIES

The course will be presented using a variety of teaching methods, including: lectures, field sampling and observation, restoration monitoring, group field activities, class projects, field notebook, reflections, and class discussions. Assignments are outlined below. More detail will be provided for each assignment in the Course Reader.

Canvas Quiz: Online Canvas quiz on assigned readings before going to Borneo

Field Notebook: Students will keep a field notebook to record sampling data, field observations, notes on class discussions during field trips, and reflections.

Field Blog: Each student will contribute at least once to the USF summer field class blog based on their experience, research and photos taken. This must be completed either in the field or within 2 weeks of returning home.

Participation: Class attendance and participation are vital parts of this hands-on learning experience. This is a field based class, so participation in the field exercises is essential. Attendance in lectures and doing the assigned readings is also critical to applying restoration ecology and ecological restoration principles to practicing them at our field sites.

Review of Restoration Documents and Presentation (4 unit only): We will review example restoration plans during the field class to help develop components of a long-term restoration plans for KOPEL. Students will work together in groups to evaluate one restoration document, conduct sampling if needed, and develop recommendations for restoration at KOPEL. A final group presentation will be given to KOPEL based on analysis of monitoring data for ongoing KOPEL restoration projects and reference sites students conduct during the field class.

Restoration and Monitoring Plan (4 unit only): Students will work with KOPEL Director and USF Instructor to continue contribute to the long-term restoration and monitoring plan developed by Summer 2017 Borneo class. In addition, students have the opportunity to help with soil sampling training of Kopel staff the week before the field class begins for part of their 4 unit requirements (optional).

EVALUATION STRATEGIES

2 UNIT SUMMER CLASS

Canvas quiz on readings	20%
Field notebook	40%
Field blog	20%
Participation	20%

4 UNIT SUMMER CLASS – (50% OF YOUR GRADE)

Document review & Presentation	30%
Final Restoration Paper	20-50%
Participation	20-50%

Grading Scale:

A+	97-100	B-	80-82
A	93-96	C+	77-79
A-	90-92	C	73-76
B+	87-89	C-	70-72
B	83-86	F	<69

FIELD TRIP PROGRAM FEE

The student fee for this course is approximately $1,000, including all lodging, meals and local transportation in Boreno from June 16 to July 1, 2018. Airfare and summer tuition is separate. Students have the option of arranging and paying for their own airfare to Kota Kinabalu, Malaysia or flying with the instructor. Limited scholarship opportunities are available as part of the Arrupe Immersion program. If you are a MSEM student and you choose the 4 unit option there is a 1 unit scholarship and if you are an undergraduate student you will get a 2 unit scholarship if you take 4 units.

ARRUPE IMMERSION CLASS

This Arrupe Immersion class provides students a short term opportunity to live, work, and reflect in economically marginalized communities in Borneo. The Arrupe Justice Immersions are opportunities for USF students to learn and be in solidarity with people living on the margins in terms of social, economic, political and environmental status.

The immersion programs attempt "to educate for solidarity within a globalized world and to experience the nitty-gritty reality of that world" by combining academic, experiential, and reflective experiences that are based on the Jesuit ideal of observing, reflecting, analyzing, and acting (The Circle of Praxis).

The Arrupe Justice Immersions provide a focused and firm foundation for future generations of ethical professionals – people who care about the future of our planet, our people, peace, and the common good and wish to be involved in changing conditions of inequity**.** As such, the Arrupe Justice Immersions aim to support our University's goal: to change the world from here.

In this class, we will incorporate two goals of the Arrupe Immersion program: working closely with local Borneo villages on restoration of ecosystems for wildlife habitat and reflecting each day on our environmental experiences.

ACADEMIC HONESTY

USF expects the highest standards of academic honesty and integrity. This precludes engaging in, causing, or benefiting from any aspect of cheating on assignments or examinations, plagiarism (intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise), forgery, multiple submissions of the same paper, or any other such activities that are not in accord with professional ethics and behavior.

ATTENDANCE POLICY

Participation in all class meetings is a requirement of the course. Exceptions can only be made in extenuating circumstances. Students who need to miss a class for a valid reason must inform the instructor in advance and complete a make-up assignment to be determined.

LEARNING DISABILITY SERVICES

Pursuant to the Americans with Disabilities Act and Section 504 the Rehabilitation Act, students with disabilities who will need reasonable accommodations for this course should contact Disability Related Services (415) 422-2613 within the first two weeks of this course. Students with Learning Disabilities may contact Learning Disability Services (415) 422-6876.

PRE-TRIP CLASS SCHEDULE

Pre-trip Class 1: February (3 hours)

- Introduction lecture, including Allyn Nobles, Center for Global Education
- Discuss field site locations and itinerary
- Review syllabus and course reader
- Discuss logistics and hand out gear/equipment list

Pre-trip Class 2: March (3 hours)

- Lecture on Restoration Ecology vs. Ecological Restoration
- Review gear needed and demonstrate equipment/gear

Pre-trip Class 3: April (3 hours)

- Discuss final trip logistics
- Cultural sensitivity training – Alejandro Covarrubias/Kique Bazan
- Practice Arrupe reflections – Star Moore, Director of Community-Engaged Learning, McCarthy Center
- Discussion on assigned readings

FIELD CLASS SCHEDULE

Typical non-travel days in the field will be organized as follows:

7:00am	Breakfast
8am-2pm	Field work or activity
LUNCH	Break for half an hour in the field or at TREC
2-4pm	Lecture
4-7pm	Free time, reflection time, or optional activities led by instructors
7-8pm	Dinner
8-9pm	Evening lecture, reflection, or night hike/boat trip
>9pm	Free time

Day 1 (6/16): Meet up in Sepilok, Borneo, Malaysia & Welcome Dinner

- Stay at Sepilok Bed and Breakfast (3 nights)
- Visit Borneo Sunbear Conservation Centre and Pygmy Elephants

Day 2 (6/17): Rainforest Discovery Center (RDC), (http://www.forest.sabah.gov.my/rdc/)

- Morning – Visit Rainforest Discovery Center
- Afternoon – Class 1: Tropical Restoration Ecology – discuss readings
- Evening walk in the canopy at the RDC

Day 3 (6/18): Forest Research Center, Sepilok

- Morning – Visit Orangutan and Sunbear Rehabilitation Centers
- Afternoon – Tour of forest research center, herbarium, and ongoing research (http://ww2.sabah.gov.my/htan_frc/MainFrame.htm)
- Evening Guest Lecture: local FRC researcher

Day 4 (6/19): Botanical hike exploring primary growth forest to the mangrove ecosystems

- Guided hike through primary growth rainforest and mangrove forest to Sepilok Laut
- Boat ride to view wildlife in mangrove ecosystems and night hike or boat trip
- Spend the night at the Sepilok Laut Center in the mangroves

Day 5 (6/20): Travel to TREC

- Travel back to TREC by boat and overland by van (2 hours)
- Introduction to Kopel facilities and safety talk
- *Lecture:* Overview of KOPEL's Conservation Program
- Show students maps of restoration sites & forest types
- Check-into Tungog Rainforest Eco Camp (TREC)

Day 6 (6/21): Introduction to KOPEL Community Restoration and Conservation

- Sunrise Wildlife River Cruise
- Visit recently logged site and Palm Oil Plantation
- Visit Takala River & Rope Bridge Orangutan crossing built over river and discuss habitat restoration requirements for wildlife
- Visit KOPEL Forest Restoration Sites - Observe Difference Before & After
- *Lecture:* Impacts of Logging and Palm Oil on Riparian Forests and Wildlife

Day 7 (6/22): Restoration Monitoring Approaches for Wildlife

- Show students wildlife camera trapping program and set up traps.
- *Lecture:* Restoration for Wildlife
- Sunset Wildlife River Cruise

Day 8 (6/23): Water Quality and Invasive Species Monitoring

- Work with Kopel community team to monitor water quality in river and oxbow lake to understand invasive species issues
- *Lecture:* Invasive species control in the Tropics – focusing on Giant Salvinia

Day 9 (6/24): Ecological Restoration Work Day

- Work on Tree Propogation at KOPEL Native Tree Nursery / Seed Collecting in Forest
- Remove giant salvinia
- *Lecture:* Introduction to Community-Based Restoration at Kopel
- Student Restoration Project Planning Session

Day 10-13 (6/25-6/28): Restoration Ecology Week (Work in Teams)

- Visit Kopel restoration sites and proposed new restoration sites
- Help Kopel locate reference sites
- Establish monitoring transects at restoration and reference sites
- Monitor vegetation, soils, hydrology, and sedimentation in restoration and reference sites
- Establish restoration experiment with former TRE MSEM students

Day 14 (6/29): Work with Kopel

- Work on presentations for research with Kopel staff

- Homestay

Day 15 (6/30): Final Activity with Kopel and Village Cultural Activities

- Morning: Tree Planting with Borneo Explorers Club and Kopel staff
- Cultural Activities and Homestay – Group dinner, music and dance performance

Day 16 (7/1): Travel back to Kota Kinabalu

- 4 unit students only – Workshop on Long-term Restoration Plan

Post-trip Class Meeting (August): Reflection on the wilderness and cultural immersion experience. Slide show of class highlights, sharing of experiences, lessons learned in tropical restoration ecology and next steps.

4 UNIT CLASS OPTION

Pre-trip Class 4: May 2018

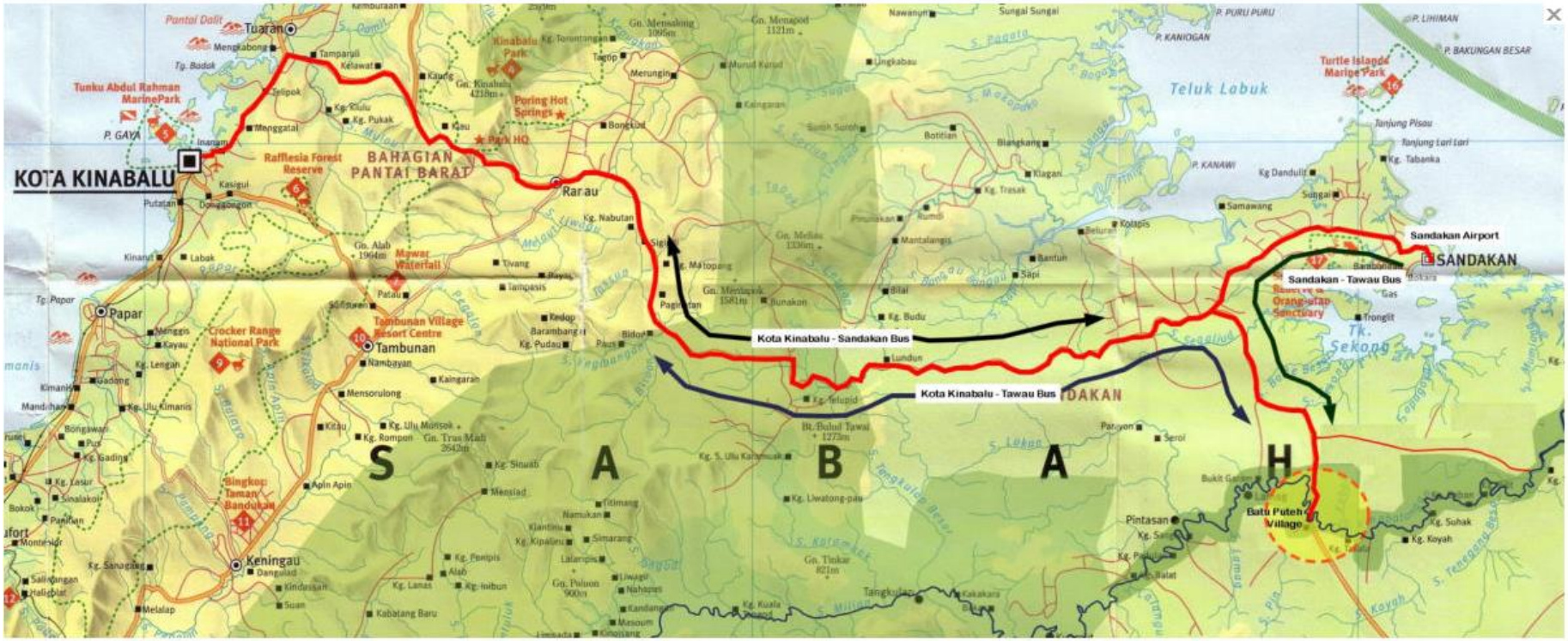
Review syllabus and assignments for 4 unit option. Assign monitoring documents for students to review. Discuss potential monitoring and group projects during class. Plan the soils sampling training for week before class starts (June 5-9).

Field Class: June 2018

Students can work on additional data collection for the final restoration papers in the field during afternoon free time (minimum of 10 hours). There is also an option to join the USF instructor to help with soil sampling training and monitoring with the Kopel staff for a week before the class starts.

Post-trip Classes: August 2018

Once back in the US, students will work on individual projects either organizing and analyzing restoration monitoring data or contributing to the long-term restoration and monitoring plan the Summer 2016 class began developing for Kopel. The group will have one final group class with the USF instructor in August to finalize sections of the plan.



Location Map for Traveling from Kota Kinabalu to KOPEL in Batu Puteh Village.

Reading List for Tropical Restoration Ecology
SUMMER 2018

A selection of these readings will be chosen for both the 2-unit and 4-unit classes. All readings will be assigned in Class 2 before the field class (and found in the course reader). There will be a Canvas quiz on the selected readings in May. We will refer to some of these articles during the field class, so students must bring the readers along.

I. Introduction/Overview

Goh, H.C. 2015. Nature and community-based tourism (CBT) for poverty alleviation: A case study of Lower Kinabatangan, East Malaysia. Malaysian Journal of Science and Space 11:42-52.

Hilderbrand, R. H., A. C. Watts, and A. M. Randle. 2005. The myths of restoration ecology. Ecology and Society **10**:19, [online] URL: http://www.ecologyandsociety.org/vol10/iss11/art19/.

Hobbs, R. J., M. A. Davis, L. B. Slobodkin, R. T. Lackey, W. Halvorson, and W. Throop. 2004 Restoration ecology: The challenge of social values and expectations. Frontiers in Ecology and the Environment **2**:43-48.

Jones, H. P. and O. J. Schmitz. 2009. Rapid recovery of damaged ecosystems. PLoS One **4**:1-6.

Kopel. Supu FR Forest Restoration Proposal. MESCOT – Supu FR Rainforest habitat & Wetland Conservation Project.

Naiman, R. J., H. Decamps, and M. E. McClain. 2010. Restoration. Pages 291-322. Riparian: Ecology, Conservation, and Management of Streamside Communities. Elsevier Academic Press, Amsterdam, The Netherlands.

Palmer, M. A., R. F. Ambrose, and N. L. Poff. 1997. Ecological theory and community restoration ecology. Restoration Ecology **5**:291-300.

Palmer, M., J. D. Allan, J. Meyer, and E. S. Bernhardt. 2007. River restoration in the twenty-first century: Data and experiential future efforts. Restoration Ecology **15**:472-481.

Society for Ecological Restoration International Science & Policy Working Group. 2004. The SER international primer on ecological restoration. Tucson: Society for Ecological Restoration International. Available at http://www.ser.org/reading_resources.asp

II. Tropical Ecosystems

Twilley, R. R. 2009. Mangrove wetlands. Pages 308-318 *in* S. E. Jorgensen, editor. Ecosystem Ecology. Elsevier, Amsterdam, The Netherlands.

Waide, R. B. 2009. Tropical rainforest. Pages 439-443 *in* S. E. Jorgensen, editor. Ecosystem Ecology. Elsevier, Amsterdam, The Netherlands.

III. Tropical Restoration Ecology

Chazdon, R. L. 2008. Beyond deforestation: Restoring forests and ecosystem services on degraded lands. Science **320:** 1458-1460.

Holl, K. D. 2013. Restoring tropical forest. Nature Education Knowledge **4**:4 http://www.nature.com/scitable/knowledge/library/restoring-tropical-forest-97756726

II. Soils

Daniels, W.L. and K.C. Haering. 2006. Concepts of basic soil science. Chapter 3 *in* The Mid-Atlantic nutrient management handbook. MAWP 06-02. Mid-Atlantic Regional Water Program. Available at: http://www.mawaterquality.org/Publications/manmh/chapter3.pdf

III. Vegetation

Whisenant, S.G. 1992. Selecting plant materials. Chapter 5 *in* Repairing damaged wildlands. Cambridge University Press, Cambridge, UK. *Entire books is available online at USF Library: www.usfca.edu/library*

D'Antonio, C. and L. A. Meyerson. 2002. Exotic plant species as problems and solutions in ecological restoration: A synthesis. Restoration Ecology **10**: 703-713.

Keng, H. 1994. Orders and Families of Malayan Seed Plants. Singapore University Press.

IV. Monitoring

Thayer, G. W., T. A. McTigue, R. J. Bellmer, F. M. Burrows, D. H. Merkey, A. D. Nickens, S. J. Lozano, P. F. Gayaldo, P. J. Polmateer, and P. T. Pinit. 2003. Science-Based Restoration Monitoring of Coastal Habitats, Volume One: A framework for monitoring plans under the Estuaries and Clean Waters Act of 2000 (Public Law 160-457). NOAA Coastal Ocean Program Decision Analysis Series No. 23, Volume 1. NOAA National Centers for Coastal Ocean Science, Silver Spring, MD.

V. Planning and Design

Clewell, A., J. Rieger, and J. Munro. 2005. Guidelines for Developing and Managing Ecological Restoration Projects, 2 Edition. December 2005. www.ser.org and Tucson: Society for Ecological Restoration International.

Coffman, G.C., K. Beechler, S. Booth, F. Hayes, A.S. Kang, A. Lal, Z. Maxon, P. Pereira, and S. Zuhdi. 2016. Draft Long-term Restoration and Monitoring Plan. Pin-Supu Forest Reserve and Wilderness Areas, Sabah, Borneo, Malaysia. University of San Francisco.

Vivian-Smith, Gabrielle. 2001. Developing a framework for restoration. Pages 39-59 *in* J.B. Zedler, editor. Handbook for restoring tidal wetlands. CRC Press, Boca Raton, FL.

VI. Animals and Endangered Species

Morrison, M.L. 2002 Habitat. Pages 41-70 (Chapter 2) *in* Wildlife restoration: Techniques for habitat analysis and animal monitoring. Island Press, Washington, DC.

Zedler, J. B. 1998. Replacing endangered species habitat: The acid test of wetland ecology. Pages 364-379 *in* P. L. Fiedler and P. M. Karieva, editors. Conservation biology for the coming decade. Chapman & Hall, New York, NY.

VII. Policy

Holl, K. D., and R. B. Howarth. 2000. Paying for restoration. Restoration Ecology **8**:260-167.

Zentner, J., J. Glaspy, and D. Schenk. 2003. Wetland and riparian woodland restoration costs. Ecological Restoration **21**:166-172.

VIII. Keeping Field Notebooks

Canfield, M.R. 2011. Field Notes on Science & Nature. Harvard University Press, Cambridge, Massachusetts.

VIV. Reflections and Social Justice

Rice. ORID: A Model for Strengthening Communication – Experience, Think, Feel, Act. K. L. Consulting, Oakland, CA

Iweala, U. 2007. Stop trying to 'save' Africa.

Crabtree, R.D. 2007. Talking back: Asking hard questions about the impact of international service learning. What we feel? Pity? Sympathy? Guilt? Conversations on Jesuit Higher Education 31:39-42