Ecosystem Science Center Annual Report

FY2022 (July 1, 2021 - June 30, 2022)

Director: Amy Marcarelli, Professor of Biological Sciences

Mission

The Ecosystem Science Center (ESC) at Michigan Technological University was established in 2004 and aims to advance knowledge through research on ecosystems. We define ecosystems following Odum (1969) as, “any unit that includes all of the organisms in a given area interacting with the physical environment so that a flow of energy leads to exchange of materials between living and non-living parts of the system.” Ecosystem science applies to natural and built environments, degraded and restored habitats, and socio-ecological systems.

Mission Statement

The mission of ESC is to advance knowledge through research on ecosystems.

Vision

ESC will be a productive, vibrant, and inclusive community of scholars at Michigan Tech who collaborate across disciplines to conduct basic research and help steward ecosystems in the Anthropocene.

Guiding Principles/Core Value

- Research excellence and integrity
- Shared governance
- Diversity, equity, inclusion and respect
- Stewardship

Summary of FY Activities and Highlights

Brief narrative summary of primary activities and accomplishments

The past year was the ESC's 18th successful year, and the final year of a 5-year renewal through December 31, 2022. ESC continues to be a leader in research activities across campus, thanks to the hard work and dedication of our members to interdisciplinary, collaborative research with partners nationally and internationally. The ESC continued to rank first across the seventeen Centers and Institutes at Michigan Tech in terms of number of research awards (86) and projects (211) in FY 22. ESC expenditures ranked fifth overall ($5,902,764), which only trailed the Tier 1 Centers and Institutes. F&A returns from these expenditures allowed us to sustain and grow our portfolio of activities in support of ecosystem-related research and student training, as detailed in this report.

This was a year of transition for ESC, including the on-boarding of Center Manager Jeff Henquinet, who began his duties in July 2021, followed by a transition from long-time director Andy Burton (CFRES) to new director Amy Marcarelli in January 2022. Starting in spring 2022, Manager Henquinet and Director Marcarelli undertook a listening program, meeting with various groups and researchers who are members of ESC to learn about their research programs and to ask how ESC can help them achieve their research goals. We evaluated our membership and invited a number of researchers from across campus who conduct ecosystem-related research but were not yet members of ESC. As a result, we added many new members, including members from several units that were not previously represented in ESC. New members joining between July 1, 2021 and June 30, 2022 include: Jeff Henquinet (ESC), Carrie Andrew, Julia Burton, Valoree Gagnon, Sarah Hoy, Luke Nave, Danielle Shannon, Steven Volker, Yinan Yuan (CFRES), Megan Berberich, Gordon Paterson (Biol Sci), Ana Dyreson (MEEM), Rob Handler, Rebecca Ong (Chem Eng), Mark Rouleau, Chelsea Schelly (Soc Sci), and Samantha Smith (CLS). Two long-time members of ESC retired in this period: Trish Burton and Glenn Larkin. A full list of members who were active during FY22 appears in Appendix A.

These leadership and membership transitions also led to an unanticipated, but major activity completed in FY22 - the revision of ESC's charter (Appendix B). The previous ESC charter dated back to the establishment of the center in 2004 and contained many details of management and administration that were not relevant to the current center's mode of operation (e.g., specifying the center's location in CFRES, requiring fund allocation to an administrative assistant to the Director) and were also superseded by more recent rules and guidelines set by the Vice President for Research office. Therefore, we completely overhauled the ESC charter to reflect our current member structure, mode of shared governance, and day-to-day operations. Members Andy Burton and Patricia Leopold were members of a working group assisting with charter revisions in June 2022. The revised charter was adopted via a vote of the membership in September 2022.

We also took this opportunity to conduct a strategic goal setting exercise, where we reviewed all of the feedback we received during the member listening sessions and envisioned where we wanted ESC to develop and grow in the next 5 years. The strategic goal setting working group included Casey Huckins, Chris Webster, Tara Bal, and Chelsea Schelly. The

timing of this exercise was also well-timed to prepare for our renewal review, which will happen in fall 2022. As part of this exercise we revised our mission, vision and values statements (see above) and set the following strategic goals to govern our next 5 years of center activities:

1. Foster a vibrant, and inclusive community of scholars who conduct research with relevance to ecosystems
2. Enhance member efforts to acquire external funds for ecosystem research.
3. Support and grow internal and external partnerships and capacity to achieve novel broader/research impacts

ESC has also been working to build strong connections with other centers and institutes. ESC members are leaders of the Environmental Restoration Hub (ERH), which was formulated in March 2021 to develop collaborative restoration projects that work across centers and institutes. This effort emerged from the Natural Resources, Water and Energy (NRW&E) Tech Forward Initiative. Similarly, ESC is currently working with leaders of the Sustainability and Resilience Tech Forward Initiative to establish a "joint center" that would function similarly to ERH, established via MOUs with ESC and GLRC. Finally, we are championing the establishment of MOUs to share F&A returns for proposals led by investigators who are deeply invested in multiple centers. Director Marcarelli has established two such MOUs with GLRC, and is exploring opportunities with individual PIs to negotiate similar agreements with centers of their choice.

Governance Structure

ESC operates through a shared-governance system, where Center members work together, with leadership of the Center Director and staff, to allocate resources and make decisions about priorities and programming. The Center is governed by a charter created by members, and which was revised in 2022 to reflect our current structure and operations (see Appendix B). The Director provides general oversight of the Center. The Director must be a voting member of the Center. Center work is carried out via a combination of member committees, the Center Director, and Center staff.

Center Membership Policy

Membership in the Center is open to all faculty, staff, postdoctoral associates, and adjunct faculty participating in research and graduate education in the subject area. Members are classified as Voting or Affiliated. Voting members are limited to those members serving as Principal Investigator, Co-Principal Investigator or Official Collaborator on currently funded extramural projects that generate overhead return. Voting membership may also be granted to faculty and staff that directly support Center activities through other funding avenues, such as direct support of ESC staff. Membership status is established annually based on activities at the start of the Michigan Tech fiscal year. Any amount of overhead generated or direct funding provided is sufficient to participate as a full voting member of the ESC. A full list of members who were active during FY 2022 appears in Appendix A.

Progress towards FY 22 goals

In the FY 21 report, we highlighted the following goals for the final year of the current center authorization:

1. Provide ESC staff to support proposal development support to ESC members;
2. Identify very large, collaborative proposal topics and funding sources;
3. Institute a successful pre-submission proposal review program;
4. Develop and institute mentoring programs for early and mid-career members;
5. Support professional development of members' students

For goal 1, Center Manager Henquinet has been working to support proposal development, providing some support to approximately a dozen proposals in FY22. Several proposals required significant support, such as a large multi-institutional proposal led by Andy Burton under the Agriculture and Food Research Initiative's Sustainable Agricultural Systems (SAS) program. Although we did not formally make progress on goals 3 or 4, building capacity and expertise in the Center Manager position is an important step to achieving these goals in future.

For goal 2, we highlight two proposals that were prepared and/or submitted during FY 22, both led by former Director Andy Burton. A 5-year, $1.56M proposal to Oak Ridge Associated Universities was submitted in January 2022 as part of a multi-university collaboration to lead a major ecological infrastructure program, which included co-PIs from Biological Sciences, Computer Science and MTRI. Dr. Burton also led the $4.7M USDA AFRI-SAS proposal mentioned above, with 4 co-PIs from CFRES that was submitted in July 2022. Both of these proposal efforts demonstrated to members how ESC resources can be leveraged to support larger proposal efforts. We aim to support submission of at least one, and hopefully 2 or more similarly large proposals in FY 22, ideally with collaborators from other Centers and Institutes at Michigan Tech.

For goal 5, ESC dedicated approximately one-third of our FY 22 expenditures to support ESC core activities and programs that benefit faculty and students, including student development through travel grants, research grants, the ESC Student Research Forum, and the very successful and well-respected Distinguished Ecologist Lecture Series. Through our conversations with faculty as part of our listening sessions, it became clear that faculty view student research awards as essential micro-grants that allow them to conduct pilot-level research with their students which sometimes result in successful proposals that emerge months to years later. Therefore, we sought in FY 22 to increase the reach of these awards by advertising them to our new and existing members who reside in units beyond those who typically apply and benefit. We awarded $22,412 total in Students Research Grants to 24 students during FY22. To account for delays in student research and particularly participation in research meetings and conferences, we increased our Student Travel award spending in FY 22 and awarded a total of $12,645 to 16 students, and have budgeted a 20% increase in this program for FY 23 as students continue to seek opportunities for in-person meetings. The ESC Student Research Forum returned to an in-person format and moved to the Rosza Center Lobby to be more welcoming of students from across campus. Thirty students presented their poster research, and 6 students received awards for their presentations.

Table 1. ESC awards, projects and expenditures from FY14 through FY22.

	Number of Awards	Amount Awarded	Number of Projects	Expenditures
FY14	88	$3,095,545	189	$3,543,913
FY15	104	$3,740,245	193	$3,072,743
FY16	89	$3,279,250	187	$3,274,666
FY17	85	$5,667,434	224	$3,760,110
FY18	67	$3,550,733	182	$3,814,755
FY19	92	$3,070,691	185	$3,875,273
FY20	88	$4,627,728	160	$3,782,119
FY21	108	$6,645,909	198	$5,006,687
FY22	86*	$4,332,499*	211*	$5,949,851*

*FY22 includes one awarded project where IRAD is shared via an MOU between ESC and GLRC, where GLRC is the primary center. Therefore, these totals differ from those listed in the "Awards and Expenditures for Michigan Tech Academic Research Centers and Institutes FY18-FY22" compiled by the VPR office.

Budget Overview

Summary of Awards and F&A Funds Generated

In FY 22, the ESC maintained its recent trend of growth in research awards (Table 1). During the 2018 renewal, ESC set the goal of increasing the value of annual research awards by approximately 30% and F&A funds generated by 40% during the renewal period ending in FY22, relative to the values for FY17. The targets were $7,350,000 for grants awarded and $685,000 in F&A generation by the end of the renewal period.

At the end of FY22, ESC had made good progress but had not fully met this goal for grants awarded, with 86 awards totaling $4,332,499 in this past year (Table 1). This number is lower than the $6,645,909 awarded in FY21, but the FY21 total was inflated by several federal agency decisions to fully fund proposals from the start, rather than in annual increments. Still, these numbers are impressive given that our members continued to deal with challenges to workload and research due to COVID-19. The FY22 awards brought ESC's total number of projects to 211, with awards from a variety of federal, industrial, public and private sources (Table 2). All of this success is due to the hard work of our members, who continue to submit proposals at a very high rate, resulting in the largest number of awards and projects among all of Michigan Tech's Centers and Institutes. A full list of proposals submitted through ESC during FY 22 is included in Appendix C.

Table 2. Sponsors of ESC awards that were active as of September 2022.

Sponsor Name/Type	Award Value ($)	Remaining Funds ($)
USDA (includes Forest Service)	$6,212,220.00	$3,005,256.00
National Science Foundation	$4,352,350.00	$1,900,181.00
Industry (primarily wood protection group)	$2,515,688.00	$1,230,798.00
Subawards from other universities (mostly federal pass-thru)	$1,732,055.00	$62,160.00
US Department of Energy	$818,550.00	$284,279.00
State of Michigan	$706,868.00	$436,812.00
National Park Service	$430,876.00	$143,343.00
US Fish and Wildlife Service	$318,424.00	$162,116.00
Other	$260,620.00	$160,611.00
Foundations/Trusts	$35,000.00	$36,130.00
Total	**$17,482,651.00**	**$7,421,686.00**

Our FY22 research expenditures reached $5,949,851 (Table 1), further demonstrating the growth in research activities over this time period. These expenditures ranked fifth among Michigan Tech's eighteen centers and institutes, trailing only APSRC, GLRC, KRC, and MTRI, all of which are Tier I centers. These increased expenditures led to an all-time high in ESC F&A generation (Figure 1). A total of $933,966 in F&A funds were generated by ESC expenditures in FY22. This far exceeds our 2018 renewal goal of $625,000 in F&A generated by FY22.

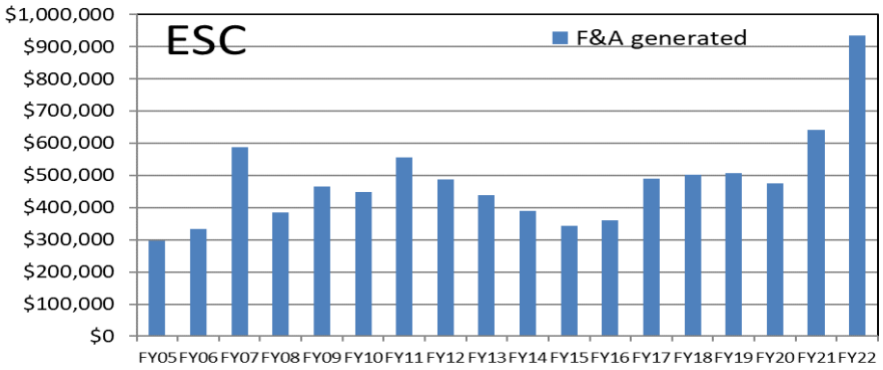


Figure 1. F&A generated by ESC grants from FY05 through FY22.

Summary of FY budget

The Center is funded through the receipt of Internal Research and Development (IRAD) funding provided by MTU in proportion to the total F&A charged on funded projects submitted through the Center. The IRAD distribution amount is governed by MTU policy and has historically ranged from 15.5 to 20%. The IRAD return split to ESC in FY2022 was 15.5%, with additional splits of 10% to the PIs, 7.5% to departments, 7.5% to colleges, and 3.5% to shared facilities. In FY22 we received $128,000 in IRAD transfers directly to ESC to support center activities. We also received a small amount of IRAD transferred from GLRC via an MOU to share IRAD on an NSF-funded grant led by Center Director Marcarelli; this amount will increase in FY23 as expenditures on this project ramp up, and also as another MOU comes into effect that shares costs for all of Director Marcarelli's funded research grants between GLRC and ESC.

Table 3. ESC expenses, income and IRAD account (E35288) balances from FY18 to FY22.

		FY18	FY19	FY20	FY21	FY22
Expenditures	S&W & Fringes	$11,606	$16,958	$18,801	$18,806	$35,541
	Supplies&Fees	$3,262	$5,176	$332	$2,003	$2,400
	Equipment	$7,671	$6,307	$26,850	$14,560	$5,000
	Student Support*^	$18,777	$34,420	$10,550	$26,350	$38,435
	Collaboration Building**	$4,703	$5,932	$4,582	$1,500	$4,812
	Member funds requests^^	$24,601	$8,346	$28,031	$6,654	$25,890
	Transfers to hubs	-	-	-	-	$4,164
	Total	**$70,619**	**$77,138**	**$89,146**	**$69,873**	**$116,243**
Income	IRAD Transfers	$92,020	$92,369	$90,161	$102,513	$128,000
	IRAD transferred from other centers (MOUs)	$0	$0	$0	$0	$141
	Other Transfers In	$4,962	$10,056	$0	$0	$0
	Total	**$96,982**	**$102,425**	**$90,161**	**$102,513**	**$128,141**
Carry Forward		**$22,495**	**$48,858**	**$74,144**	**$75,159**	**$107,799**
Year End Balance[1]		**$48,858**	**$74,144**	**$75,159**	**$107,799**	**$119,697**

[1]Excludes encumbrances at year end

*student travel and research awards, Research Forum

**DELS, ESC coffee, meetings

^$11,000 in student research awards from spring 2020 were funded in FY21

^^FY21and 22 values include expenditures
from member funds requests that were awarded in prior years

FY 22 IRAD Use

In FY 22, we spent 90.7% of IRAD generated on expenses to support ESC member capacity and core programs. For FY2022, spending priorities included:

1. Funding a portion of the Director's annual salary to support efforts described above.
2. Increasing funds allocated to staff (i.e. the new Center Manager) to support proposal development and post-award project management for large proposals.
3. Funding member requests likely to lead to successful proposals, such as preliminary data generation, travel for collaborative proposal development, help in purchasing needed equipment and repair/refurbishment of existing essential research capabilities.
4. Funding release time from teaching for ESC members who are developing and preparing large ($1 to $10 million), collaborative proposals (lower priority).

For priority 1 and 2, in FY 2022 we spent 30.6% of our IRAD revenue on supporting the Center Director and Manager. The center directors were supported for a total of 3.75 weeks of effort (73 hrs for Director Burton in summer 2021, 70 hours for Director Marcarelli in summer 2022). We also funded 0.25 FTE for Center Manager Henquinet, with the remainder of his 0.75 FTE position funded from the NRW&E Tech Forward Initiative. For priority 3, we spent 28.3% of IRAD revenue on a variety of research seed and cost-share opportunities. We funded 3 new faculty research seed proposals, and also funded expenditures from seed proposals awarded in prior fiscal years. We provided proposal cost share for two REF-research seed awards to ESC members, and two successful NSF MRI proposals (Table 4). We also contributed to services to assist member research: a university-wide license for the survey software Qualtrics, and support of ACMAL equipment service contracts. We did not spend any funds on priority #4, as we had no requests from members for this kind of support in FY 22.

The remainder of our FY 22 budget was dedicated to support ESC core activities and programs, including 33.1% to support student development through travel grants, research grants (see full list of students awards in Appendix D) and the ESC Student Research Forum, 4.1% for collaboration-building activities including a weekly coffee hour and the Distinguished Ecologist Lecture Series, and the remainder for administrative supplies and services.

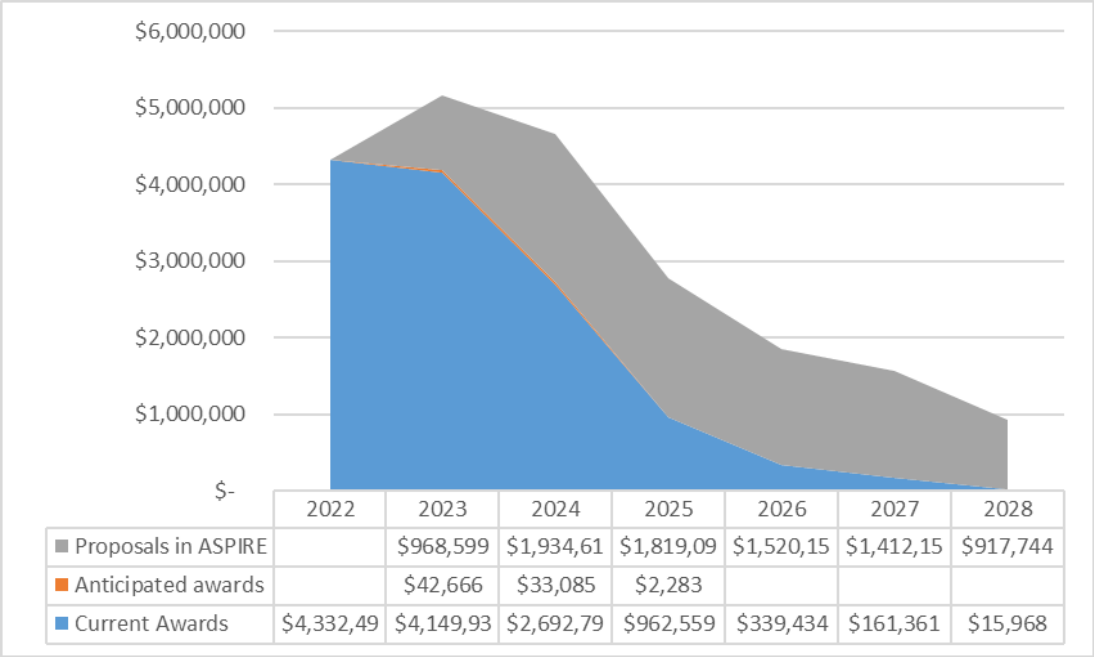
The ESC continues to be in sound financial condition. As of June 30, 2022, the ESC IRAD account (E35288) balance was $119,698. This positive balance is the result of increases in IRAD income in recent years, combined with continued lags in spending due to COVID-19. In particular, expenses for student travel and research grants were low in FY 2020, and the continued reduction in travel greatly reduced costs for the Distinguished Ecologist Lecture Series, as all visits in FY 21 and 22 were virtual. The positive balance in the ESC account will enable us to continue to support equipment purchases and provide research seed and cost-share support to members, while also increasing our support of the ESC manager position from 0.25 to 0.5 FTE in FY 23.

Table 4: Summary of member support spend and/or awarded in FY 22, including research seed awards and cost-share requests

PI Name	Award Date	Project title	Award Amount
Research seed awards			
Jared Wolfe	Fall 2021	Developing and commercializing technology to protect migratory songbirds from building collisions	$3,000
Molly Cavaleri	Spring 2022	Acclimation of Quercus rubra root respiration across a Midwest temperature gradient	$6,000
Rod Chimner	Spring 2022	Developing a mountain peatland mapping program in the Rocky Mountains	$6,000
Cost-share commitments			
Yinan Yuan	Spring 2021	REF-seed award	$3,000
Jared Wolfe	Fall 2021	REF-seed award	$2,000
Evan Kane	Spring 2021	NSF MRI - NMR (proposal led by Marina Tasanova) (*proposal submitted in FY 21, funds spent in FY22)*	$5,000
Tao Liu	Spring 2022	NSF MRI - GPU cluster (proposal led by Dukka KC)* (*funds will be used in FY 23)*	$5,000

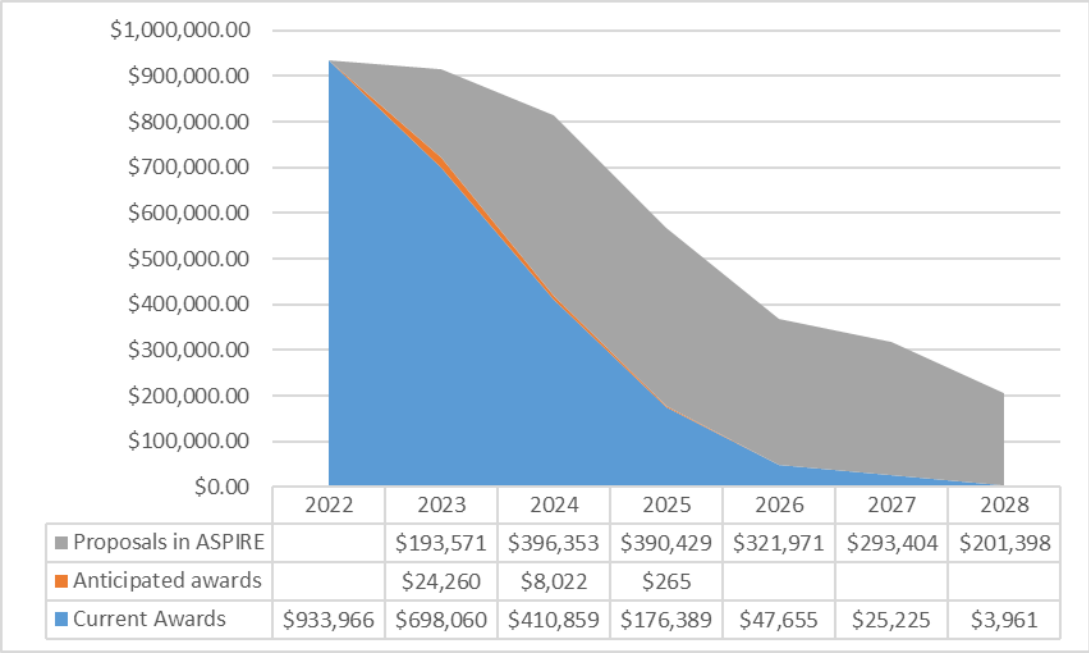
FY 23 Budget Projections

Budget projections (see below) suggest that ESC is in a good position to continue to maintain and grow our IRAD return and supported activities in FY 23 and beyond. ASPIRE projections show robust expectations for maintaining the FY22 level of awards (Figure 2) and F&A generation (Figure 3) through FY24, due primarily to the two large, 5-year awards currently in review that were led by former Director Burton. Even if neither of these are funded, our currently funded awards will maintain a similar rate of funding for at least FY23 (Figure 2). Our past records of F&A return show a long-term trend for ESC F&A generation to be 80 to 85% of the ASPIRE projection. Therefore, we estimate that more than $775,000 in F&A should be generated by ESC in FY 23, which allows us to confidently plan to sustain and grow our commitments to ESC's core programs and strategic goals.



	2022	2023	2024	2025	2026	2027	2028
Proposals in ASPIRE		$968,599	$1,934,61	$1,819,09	$1,520,15	$1,412,15	$917,744
Anticipated awards		$42,666	$33,085	$2,283			
Current Awards	$4,332,49	$4,149,93	$2,692,79	$962,559	$339,434	$161,361	$15,968

Figure 2: ASPIRE projections for ESC remaining balance from existing awards, anticipated increments of existing awards, and proposals in progress for FY 23 through 28. FY 22 are actual values included for comparison



	2022	2023	2024	2025	2026	2027	2028
Proposals in ASPIRE		$193,571	$396,353	$390,429	$321,971	$293,404	$201,398
Anticipated awards		$24,260	$8,022	$265			
Current Awards	$933,966	$698,060	$410,859	$176,389	$47,655	$25,225	$3,961

Figure 3: ASPIRE projections for ESC F&A generation from existing awards, anticipated award increments, and proposals in review for FY 23 through 28; FY 22 are actual values included for comparison.

Future Plans and Goals

Strategic Goals for The Next Five Years

As part of our charter and strategic plan revision approved in Sept 2022, ESC has set the following strategic goals to govern our next 5 years of center activities:

1. Foster a vibrant, and inclusive community of scholars who conduct research with relevance to ecosystems
2. Enhance member efforts to acquire external funds for ecosystem research.
3. Support and grow internal and external partnerships and capacity to achieve novel broader/research impacts

The strategic plan also included a range of actions to meet these strategic goals, which are detailed in the full strategic plan included as Appendix B to this report. In the next section we will highlight a few specific goals that will guide our actions both for the next year.

An overarching, long-term goal of Ecosystem Science Center continues to be to increase extramural grants and IRAD return generated for ecosystem-related research at Michigan Tech. This is the core activity needed to support our mission and any strategic activities of the center. At the last renewal review, we set the goal of increasing the value of annual research awards by approximately 30% and F&A funds generated by 40% during the renewal period. Given the impressive growth of IRAD awards and F&A generated in the past 5 years, we propose to extend this goal for the next 5-year period, but to use the average of FY 21 and 22 as our benchmarks for growth given that the FY21 total was inflated (and the FY22 total deflated) by several federal agency decisions to fully fund proposals from the start, rather than in annual increments. Thus, our new targets will be $7,135,000 in awards and $1,150,000 in F&A generation by the ESC by the end of the next renewal period. We propose to meet these targets by (1) continuing to support our core researchers whose industry and USFS contracts form the core of ESC awards (Table 2), while (2) continuing to provide support and leadership on ecosystem-specific research awards from NSF, DOE and other federal agencies, and (3) pursuing new opportunities to participate in and lead large, multi-investigator and multi-university programs and proposals.

Specific priorities for FY 2023

Based on the 3 goals from our strategic plan and our long-term goal to increase extramural grants and IRAD return, we will focus on the following specific priorities for FY 2023:

1. Encourage collaboration between ESC and other MTU research centers/institutes and facilities through MOUs, research hubs, collaborative proposals, and other opportunities.

ESC has made great strides in the past year growing our members to be inclusive of more departments and colleges across campus, which opens up opportunities for collaboration not only among these individuals, but also among Centers and Institutes where these members are affiliated. For example, many of our members are also active members of GLRC and have

active collaborations with scientists from MTRI; Director Marcarelli and members Kane, Techtmann, Tao and others have current collaborative grants with members of ICC; and there are opportunities to build collaborations with IPEC, HRI and other new/emerging centers and institutes on campus. ESC will continue to support and attempt to grow these partnerships by:

- Co-sponsoring ESC coffee meetings with other centers and institutes at least once per month in FY 23
- Continuing to work to establish a joint center focused on Sustainability and Resilience with GLRC via MOUs
- Explore ways to increase ESC member involvement with the Environmental Restoration Hub (ERH)
- Provide logistical and financial support for efforts to establish The Carpentries software and data training programs on campus with ICC

2. Sustain and grow ESC staff to support pre-award activities and enhance post-award programming and effectiveness

Currently, ESC supports Center Manager Jeff Henquinet as 0.25 FTE, with an additional 0.5 FTE from NWR&E Tech Forward, for a total 0.75 FTE. In January 2023, ESC will increase their support to 0.5 FTE, with the goal of fully supporting the Center Manager position by 2024. We expect that the Manager's time will increasingly be spent supporting proposal development as we continue to pursue large proposals to support new and existing ESC programs. ESC members have also expressed interest in project management support, particularly in planning workshops, preparing reports, and administering complex projects. In FY 23, we will continue to explore opportunities to diversify support of the Center Manager position by integrating direct support for program management activities, especially by working with members to budget for these tasks when preparing their proposals.

3. Identify and lead large, multi-institution, interdisciplinary proposals related to our mission and vision (e.g., climate change, stewardship, transdisciplinary research)

ESC has long aimed to submit large, collaborative proposals - for example, this was a key goal presented during the 2016 request for renewal. We have been stymied in the past by limited support staff for such proposals, and limited time/support of the Center Director to lead such activities. We have addressed these challenges, and have also gained experience in the past year with such large proposal efforts, and are now well-positioned to participate in and/or lead such efforts. We have long aimed to submit a student training proposal (NRT, REU site) related to Ecosystem Science - Director Marcarelli plans to lead an REU site proposal for Fall 2023 submission around ecoinformatics, or the integration of data science and ecological research. We have identified a team of PIs from Biological Science, Computer Science and Data Science to work on this proposal and will start meeting in fall 2022 to plan this submission. We will seek additional opportunities to build teams to respond to timely proposals; NSF INCLUDES, NRT, URoL:EN, IntBIO, MSB-NES and DISES are all possible targets for such programs, as are USDA AFRI, DOE/NASA ROSES, and other emerging opportunities.

4. Build visibility of ESC research external to Michigan Tech (social media, marketing, agency visits)

Although ESC is well-respected within the Michigan Tech community, we are not well-known as an entity on the national level. We routinely hear from visiting scholars (such as the speakers from the Distinguished Ecologist Seminar series) that although they knew of individual ecosystem scientists at Michigan Tech, they had no idea that we have such a broad and cohesive research community. Although it will take time to increase our visibility, we propose this year to take some initial steps to address this:

- Establish a social media presence for ESC (Twitter, Instagram), potentially with support of a graduate student intern to assist with content and posts.
- Support visits by the Center Director and members to visit with funding agencies, lawmakers, and others to share our activities and expertise, and explore opportunities for funding and partnership.

On the second point, after renewal we hope to spend some time meeting with Research Development staff to discuss opportunities for engagement and outreach.

Space or Facility Needs/Goals For Center/Institute And Members

As of right now ESC space is limited to office space for the Center Manager (129 Noblet). Director Marcarelli conducts ESC business in her regular faculty office, Dow 727. Although this is sufficient, it is a limitation that ESC does not have a space-based identity - there is no place where someone can drop in to find us, where members can gather for informal meetings or discussion, or where the Director and Manager can easily work together on projects and proposals. A welcoming home for the ESC would be a great development, but it is not essential for the long-term success of the center.

In spring 2022, there were some extended conversations among ESC members who are doing molecular biology and genetics research about needs to improve access to and reduce redundancy in lab equipment, improve access to sequencing labs, and address computing challenges specific to bioinformatics. Although there were few cohesive solutions that emerged, we wanted to highlight this as an important challenge and a potential opportunity to address research challenges for a community that has not had a cohesive voice since the dissolution of the BRC some years ago.

Table 5: ESC projected budget for FY 2023, in comparison to budget and actual spending for FY 21 and 22. The majority of the planned budget is dedicated to supporting existing ESC programming. The negative budget projection is due to our conservative estimates for IRAD revenue based on 80-85% of the projected IRAD in ASPIRE and the current center return rate of 15.5%. Carryover budget of $119,000 from FY 22 provides a buffer to support these programs, and also to support strategic activities outlined above.

Item	Budget for FY2021	*Actuals for FY2021*	Budget for FY2022	*Actuals for FY2022*	Budget for FY2023
Income					
ESC IRAD Revenue	$100,000	*$102,513*	$102,000	*$128,142*	$120,770
IRAD Sharing Revenue					
Direct Support					
Other Income					
Expenses					
Admin					
-Center Director salary and fringe (actuals include all staff in FY21)	$18,000	*$18,806*	$18,000	*$16,326*	$15,000
-ESC Center Manager salary and fringe	$31,500	*$0*	$21,360	*$19,215*	$27,540
-Supplies & equipment					$100
-Training, travel, misc					$500
Direct Student Support					
-Student research grants (transfer to E35299)	$18,000	*$23,750*	$20,000	*$22,412*	$25,000
-Student travel grants (tranfser to E35292)	$8,000	*$1,500*	$10,000	*$12,645*	$15,000
Member support					
Equipment & REF support (mostly cost share)	$12,648	*$14,559*	$20,000	*$10,000*	$20,000
Member research grants (transfers to E36100)	$20,000	*$6,654*	$20,000	*$22,890*	$20,000
Events					
-Coffee Hour					$2,400
-DELS					$2,500
-Fall Welcome					$600
-Research Forum					$2,750
-Other Events					
Other (coffee, DELS, supplies, welcome)	$5,000	$4,603	$7,500	$8,591	NA
Other expenses					
IRAD Transfers Out (to hubs)				*$4,164*	$4,500
Total expenditures	**$113,148**	**$69,873**	**$116,860**	**$116,243**	**$135,890**
Net income	-$13,148	$32,640	-$14,860	$11,899	-$15,120

Challenges and Barriers

Although ESC has had several very strong years, we do face challenges to continued growth, particularly as we continue to exist as a Tier 2 center with limited support staff and overhead returns, but with aims to grow our research portfolio and services for members. As ESC shifts to fully support the Center Manager position, we will need to grow our overhead return accordingly. We have adequate carry-over funds to support several years of budget deficits, but if we do not meet our long-term IRAD targets we may need to limit some of our programs to maintain the center manager position.

A continued challenge is the variable IRAD return rates to Centers and Institutes, which makes long-term planning for support of staff and programs challenging. Our growth in IRAD revenue to ESC are particularly impressive considering the reduction in F&A return from 20% to 18% in FY 2018, and more recently to 15.5% in FY 22. A return to 18% return for centers and institutes as recommended by the IRAD Task Force report in December 2021 would be a major benefit as we work to grow support for ESC staff.

A specific barrier to meeting our strategic priorities for FY 23 is the need for a more transparent system to share credit and F&A for large, collaborative proposals. Establishing MOUs are effective for moving F&A between centers, but they do not show up in the year-end reporting or account by VPR, and it is a challenge to reconcile total awards, expenditures and F&A generated for accurate year-end reporting. A good system is needed for enabling members of multiple centers to work together, and for the centers to share equally in both the F&A and the recognition for their research programs.

A related point, although not necessarily a challenge, is the need to monitor the effects of the new research hubs/joint centers on Center IRAD returns. The goal of these joint centers is to stimulate research at the interfaces between established centers and institutes, and if they do that, they should result in a net benefit in the form of new proposals that would not have been submitted or funded previously. However, if such new research activity does not emerge, the net effect could be a siphoning away of center IRAD to a subgroup of researchers, which is counter to the mission of ESC. We will closely monitor the net effects of these agreements on the IRAD returns and renegotiate the MOUs as needed to insure the long-term success of ESC.

Appendix A. Member List

Name	Position, Unit	Areas of Expertise
Carrie Andrew	Research Assistant Professor, CFRES	Fungi and plant ecology; Data science and spatiotemporal modelling
Tara Bal	Assistant Professor, CFRES	Forest Health Management and Monitoring, Earthworm Invasion Ecology, Wood Decay Testing, Insect, Fungi, and Environmental Education, Wild Foods
Megan Berberich	AQUA Lab Technician	Biogeochemistry, Ecosystem ecology, Field and lab research support
Kristin Brzeski	Assistant Professor, CFRES	Conservation genetics, Canid genomics, Noninvasive methods in wildlife management, Wildlife immuno- & epi-genetics, Applied conservation in Central Africa
Andrew Burton	Professor/Associate Dean, CFRES	Forest responses to global change factors, Belowground processes, Carbon and nutrient cycling, Physiological ecology of tree roots, Undergraduate involvement in research
Julia Burton	Associate Professor, CFRES	Silviculture, Functional ecology, Conservation of biodiversity in managed forests, Climate change adaptation and mitigation Forest community and stand dynamics, Disturbance ecology
Angie Carter	Associate Professor, Social Science	Environmental sociology, Rural sociology, Community-based and participatory research, Social movements and social change
Molly Cavaleri	Professor, CFRES	Forest canopy structure and function, Forest response to global change, Carbon and water cycling through forests, Tree ecophysiology, Stable isotope ecology, Invasive tree species
Rod Chimner	Professor, CFRES	Peatland and wetland restoration, Peatland and wetland carbon cycling, Mountain wetlands, Tropical peatlands, Ecosystem carbon cycling, Wetland ecohydrology
Paul Doskey	Professor, CFRES	Environmental Biogeochemistry, Biogeochemistry of Surface- Atmosphere Exchange, Atmospheric Organic Chemistry, Environmental Analytical Chemistry
Ana Dyreson	Assistant Professor, ME-EM	Solar photovoltaic and thermal power plants, Electricity grid operational modeling, Energy-water nexus
Jennifer Eikenberry	Assistant Research Scientist, CFRES	Stable isotopes, Forest ecology, Mass spectrometry
David Flaspohler	Professor and Interim Dean, CFRES	Conservation biology, Avian ecology and reproduction, Cascading effects of deer overbrowse, Island ecology
Val Gagnon	Assistant Professor, CFRES	University-Community partnerships, Research engagement, Equitable practice and design in research, Environmental justice and policy, Indigenous / Native American studies

Name	Position, Unit	Areas of Expertise
Kathleen Halvorsen	Associate Vice President for Research Development Professor Social Sciences/CFRES	Woody bioenergy, Climate change, Natural resource policy, Biodiversity policy, Bioenergy policy
Rob Handler	Senior Research Engineer, Chemical Engineering	Sustainable water and energy systems, Life-cycle assessment, Bioproducts and bioenergy, Sustainable materials and manufacturing, Aquaponics and hydroponics
Jeffrey Henquinet	Center Manager, ESC	Grant writing, Project management, NEPA and environmental compliance, Natural resources policy
Erika Hersch-Green	Associate Professor, Biological Sciences	Plant evolutionary ecology, Ecological genetics, Eco-evolutionary dynamics
Sarah Hoy	Research Assistant Professor, CFRES	Predator-prey interactions, Animal ecology and conservation, Population biology, Life-history trade-offs
Casey Huckins	Professor, Biological Sciences	Ecology of lakes, streams, and riparian interface with terrestrial systems, Fish ecology, biology, functional morphology, Effects of land use on ecological systems, Biomonitoring for research and restoration, Effects of invasive species
Mike Hyslop	Teaching Professor, CFRES; Master of GIS Program Director	Geographic information systems, Cartography, Global positioning systems, Great Lakes Quaternary (glacial) geomorphology
Maria Janowiak	NIACS Director, USFS Northern Research Station	Translating science related to climate change and carbon into usable information, resources, and tools for forestry and conservation professionals
Mickey Jarvi	Assistant Teaching Professor, CFRES	Forest ecology, Use of multispectral and hyperspectral imagery attached to unmanned aerial vehicles investigate forestry and natural resource issues
Chandrashekhar Joshi	Department Chair and Professor, Biological Sciences	Cellulose and lignin biosynthesis in trees, Wood formation, Tree growth and development, Engineering trees, Forest bioinformatics
Martin Jurgensen	Research Professor, CFRES	Forest soil productivity, management and sustainability, Global climate change impact on soil biology, Organic matter decomposition and ecosystem nutrient cycling
Evan Kane	Associate Professor, CFRES	Soil carbon, Plant/soil relationships, Decomposition, Dissolved organic carbon, Wildfire, Black carbon
Carsten Küelheim	Associate Professor, CFRES	Genetic basis of trait variation, Plant adaptation to local environment, Plant secondary metabolism, Functional genomics of plant defenses
Nancy Langston	Professor, Social Sciences	Toxics, forested watersheds, and northern lakes, Environmental history, Watershed change and water quality,

Name	Position, Unit	Areas of Expertise
		Mining history
Patricia Leopold	Research Scientist I, CFRES & Climate Change Outreach Specialist, NIACS	Ecosystem response to climate change, Climate change adaptation and management strategies, Outreach and technical transfer of climate change tools and resources
Erik Lilleskov	Research Ecologist and Director's Rep., USFS NRS; Adjunct Professor, CFRES	Forest ecology, Ecosystems ecology, Physiological ecology, Community ecology, Fungal ecology, Mycorrhizal fungi, Molecular ecology, Soil ecology, Global environmental change impacts on forest ecosystems, Invasive species impacts, Biogeography of invasive soil organisms
Fengjing Liu	Associate Professor, CFRES	Ecohydrology in forests, Watershed hydrology in montane and lake-dominated catchments, Biogeochemistry in snow-dominated, agricultural and forested catchments, Numerical modeling in watershed hydrology, Forensic hydrology with natural geochemical and isotopic tracers
Tao Liu	Assistant Professor, CFRES	Remote sensing, Change detection, Natural disaster mapping, Invasive species mapping Landcover mapping, Vegetation property extraction with remote sensing techniques
Ann Maclean	Professor, CFRES	Remote sensing, Digital image processing, Geographic information systems, Spatial modeling
Carol MacLennan	Research Professor, Social Sciences	Environmental anthropology/political ecology, Anthropology of industry (mining, sugar), Hawai`i and the Pacific, Anthropology of public policy
Amy Marcarelli	ESC Director and Professor, Biological Sciences	Limnology, Ecosystem ecology of streams and rivers, Biogeochemistry
Luke Nave	Research Associate Professor, CFRES	Forest ecology, Soil carbon management, Biogeochemistry, Data synthesis and meta-analysis
Jill Olin	Assistant Professor, Biological Sciences	Ecology of aquatic systems, Fisheries science, Aquatic-terrestrial energy linkages, Dietary biomarkers (e.g., stable isotopes, fatty acids, compound-specific isotopes of AA and FA), Trophic ecology of top predators in marine, estuarine and coastal communities, Predator-prey interactions
Rebecca Ong	Associate Professor, Chemical Engineering	Development of fuel and products from lignocellulosic materials and upcycled waste plastics, ustainability of the bioenergy and bio-based product industries.
Todd Ontl	USDA Northern Forests Climate Adaptation Specialist, NIACS	Understanding the motivations for and implementation of climate adaptation actions on forests across the Midwest and Northeast region

Name	Position, Unit	Areas of Expertise
Gordon Patterson	Assistant Professor, Biological Sciences	Legacy and emerging pollutants, Ecotoxicology, Great Lakes fisheries, Multiple stressors, Fisheries bioenergetics
Judith Perlinger	Professor, Civil and Environmental Engineering	Air and water quality, Atmosphere-biosphere exchange of chemicals, Micrometeorology, Environmental analytical chemistry, Sustainability
Rolf Peterson	Research Professor, CFRES	Mammalian ecology, Predator-prey relationships, Ecology and behavior of gray wolves
Sigrid Resh	Research Assistant Professor, CFRES Coordinator, KISMA	Forest carbon dynamics, Soil sustainability, Invasive species education/outreach, control, and research
Mark Rouleau	Associate Professor, Social Sciences	Social simulation (agent-based modeling), Policy analysis, International relations, Sustainability assessment, Norm evolution and social influence
Mark Rudnicki	Professor of Practice, CFRES	Forest Biomaterials, Tree biomechanics, Wind and trees, Dendrochronology, Extension and Outreach
Chelsea Schelly	Associate Professor, Social Sciences	Alternative technology adoption, Renewable energy technologies, Renewable and alternative technology policy, Sustainable communities, Energy conservation and consumption practices, Self-provisioning, Environmental education
Danielle Shannon	Research Scientist, CFRES	Climate change and adaptation, resources management, decision-making
Terry Sharik	Research Professor, CFRES	Academic leadership in natural resources, Educational reform in natural resources, Trends in natural resource enrollments, Regeneration ecology of forests
Samantha Smith	Assistant Professor, Cognitive and Learning Sciences	Cognitive demand of physical tasks, Cognitive state assessment, Multitasking, Sustained attention
Andrew Storer	Interim Provost and Professor, CFRES	Forest insect ecology, Insect/fungus/plant interactions in forest ecosystems, Impacts of exotic species on forest ecosystems, Interactions among fire, insects and disease in forests, Urban forest health
Christopher Swanston	Research Ecologist USFS and Adjunct Professor, CFRES	Soil organic carbon stabilization and cycling, Radiocarbon analysis and interpretation, Forest response and adaptation to climate change, Landscape scale conservation

Name	Position, Unit	Areas of Expertise
Stephen Techtmann	Associate Professor, Biological Sciences	Environmental microbiology, Next-generation sequencing technology and bioinformatics, Microbial physiology and biochemistry, Microbes as sensors for the environmental impacts of oil and gas production, Microbial-mediated remediation of crude oil contamination
Colin Tucker	Ecologist/Lab manager, USFS Northern Research Station	Analysis of environmental samples for understanding carbon cycling and potential impacts of climate change on ecosystems
Noel Urban	Professor, Civil and Environmental Engineering	Environmental cycles of major and trace elements, Sediment diagenesis and stratigraphy, Chemistry of natural organic matter, Wetland biogeochemistry, Environmental impact and fate of pollutants, Influence of organisms on the chemical environment, Role of chemical environment in controlling populations
Trista Vick-Majors	Assistant Professor, Biological Sciences	Microbial ecologist who studies the reciprocal relationships between microbial communities and biogeochemical processes in aquatic ecosystem
Steven Voelker	Associate Professor, CFRES	Dendrochronology, Forest Ecology & Paleoecology, Stable Isotope Geoscience, Carbon Cycling, Forest Health, Disturbance Ecology, Plant Ecophysiology
Ken Vrana	Director, Isle Royale Institute	Wildland experiential outreach
John Vucetich	Professor, CFRES	Demographic and genetic elements of population biology, Ecology of wolves and moose, Environmental ethics
Leah Vucetich	Research Assistant Professor, CFRES	Isle Royale wolf genetics, Field research methods
Christopher Webster	Professor, CFRES	Gap dynamics and disturbance ecology, Invasion biology of exotic species, Landscape ecology, Plant community response to herbivory, Restoration silviculture, Wildlife habitat relationships
Hairong Wei	Professor, CFRES	Identification of genes regulating complex traits via systems biology approaches, Gene expression data analysis, Gene network construction and decomposition, Developing software for mining large-scale biological data, Genomics of wood formation
Richelle Winkler	Associate Professor, Social Sciences	Rural sociology, Population and environment, Environmental sociology, Community engaged scholarship, Internal migration, GIS and spatial analysis
Jared Wolfe	Assistant Professor, CFRES	Wildlife conservation in working landscapes, Temperate and tropical avian ecology, Demographic modeling, Avian molts and plumage

Name	Position, Unit	Areas of Expertise
Xinfeng Xie	Associate Professor, CFRES	Carbon materials derived from wood, lignin, and cellulose; Integrated thermochemical conversion and fractionation of lignocellulosic biomass; Carbon-polymer composites and hybrid materials; Wood protection and preservation; Wood properties, quality, and modification
Yinan Yuan	Assistant Professor, CFRES	Identification and characterization of natural antisense transcripts in woody plants, Alternative splicing and salicylic acid metabolism in populus, Sequencing complex plant genome through gene-enriched methods

Appendix B.

Ecosystem Science Center (ESC) Charter

Approved: September 13, 2022

Preamble: This charter governs the operations of the Ecosystem Science Center (Center) at Michigan Technological University. The Center was established in 2004 and aims to advance knowledge through research on ecosystems. The Center strives to foster a vibrant, and inclusive community of scholars who conduct research with relevance to ecosystems, enhance member efforts to acquire external funds for ecosystem research, and support and grow internal and external partnerships and capacity to achieve novel broader/research impacts.

Contents

1. Mission

The mission of ESC is to advance knowledge through research on ecosystems.

2. Description of Proposed Activities

The Center brings together faculty and staff interested in the study of ecosystems, which we define following Odum (1969) as, “any unit that includes all of the organisms in a given area interacting with the physical environment so that a flow of energy leads to exchange of materials between living and non-living parts of the system.” Ecosystem science applies to natural and built environments, degraded and restored habitats, and socio-ecological systems.

The Center provides the guidance and resources necessary to attract funding from external sources to enhance and grow ecosystem science research and education. The Center operates through a shared-governance system, where Center members work together, with leadership of the Center Director and staff, to allocate resources and make decisions about priorities and programming. The Center supports its members through activities, such as, but not limited to, identifying funding opportunities, helping researchers develop externally funded research proposals, assisting in the creation and management of multiple investigator proposal and project teams, assisting with post-award project management and compliance, providing seed funding to support research development and acquisition of shared equipment, supporting members' graduate and undergraduate researchers through small awards, and providing opportunities to promote collaboration both at MTU and externally.

3. Governance Structure and Management

3.1 Membership

Membership in the Center will be open to all faculty, staff, postdoctoral associates, and adjunct faculty participating in research and graduate education in the subject area. Members are classified as Voting or Affiliated.

3.2 Voting Members

Voting members are limited to those members serving as Principal Investigator, Co-Principal Investigator or Official Collaborator on currently funded extramural projects that generate overhead return. An Official Collaborator contributes to the scientific development or execution of the project in a substantive, measurable way and has attached a letter of collaboration to an extramurally funded grant that generates overhead return at the time of submission, but they are not listed as a Co-Principal Investigator on the grant cover sheet. Voting membership may also be granted to faculty and staff that directly support Center activities through other funding avenues, such as direct support of ESC staff. Membership status is established annually based on activities at the start of the Michigan Tech fiscal year. Any amount of overhead generated or direct funding provided is sufficient to participate as a full voting member of the ESC.

3.3 Affiliated Members

Affiliated members are those that do not qualify as a voting member, i.e. are not involved in active grants that generate overhead or provide direct financial support. Affiliated members can participate in all Center activities and apply for most funding opportunities, but they cannot vote on

the allocation of Center resources, appointment of the Director, changes in the Center Charter or any other action that requires a formal vote by the voting members.

3.4 Director and Staff

A Director will provide general oversight of the Center. The Director must be a voting member and is installed, renewed, or removed by a simple majority vote of voting members by ballot. The Director will serve a four-year renewable term. Nominations of voting members will be accepted for at least one week upon notification to all members. Notice of an election should be provided to all members at least two weeks in advance. Voting will occur following the process set out below. Should a Director not be able to continue in their role, a temporary Director may be elected as described above or appointed by the Vice President for Research.

The Director shall perform such duties and exercise such powers as are necessary or incident to the supervision and management of the Center and shall see that the orders and resolutions as authorized by the membership are carried into effect. The Director is responsible for meeting the requirements and guidance for MTU centers and institutes as provided by the office of the Vice President of Research. Unless prohibited, the Director may delegate some or all of the duties and powers of their office, however, the Director remains accountable for proper and efficient performance of any delegated duties.

Staff may be hired using ESC funds to support the center mission, including a center manager, accountant, research scientists, or others. Any positions should be approved by the membership. The Director will have supervisory authority over all staff. Staff are considered Affiliated Members of the Center, but can become Voting Members if they meet the stated requirements.

3.5 Committees

The membership or the Director may from time to time appoint such committees as deemed proper and may prescribe the functions, duties, duration, and terms of membership of such committees.

3.6 Financial Management and Resource Allocation

The Center is funded through the receipt of Internal Research and Development (IRAD) funding provided by MTU in proportion to the total F&A charged on funded projects submitted through the Center. The IRAD distribution amount is governed by MTU policy and has historically ranged from 15.5 to 20%.

Members will collectively decide how to distribute resources among its programs and activities at the first meeting of each semester of the academic year. Priorities for the distribution of resources will ideally be decided by consensus, but a simple majority vote will be used to make decisions. Members have the responsibility for making proposals for the distribution of resources through the meeting agenda and planning activities in advance so that all voting members have a voice in the distribution of resources. The Director shall have signing and spending authority consistent with the direction provided by the membership.

The Director will provide an updated summary of the ESC finances at the beginning of each of the four annual meetings.

3.7 Meetings

The ESC will hold at least four meetings each academic year, two in each academic semester.

All meetings will be announced at least two weeks in advance and members will be able to forward agenda items for each meeting to the Director. The Director will distribute an agenda at the beginning of each of the four annual meetings, and meetings will follow the agenda as amended by members at the beginning of each meeting.

Minutes of each meeting will be taken by a designated attendee and they will be distributed to members within two weeks following each meeting.

3.8 Voting

Voting shall take place via ballot either electronically or in meetings of the whole where a quorum has been reached. For any meeting of the whole where business is conducted, a quorum will consist of 50% + 1 of all Voting Members. Votes via electronic ballot require notice to all members, a 50% +1 response rate of Voting Members, and should follow an opportunity for discussion of the matter. A motion will pass with a majority of votes, unless a larger vote is required as set forth in this charter or another authority. A voting period should typically last one week with notice of the voting period provided in the notice.

3.9 Annual Report and Renewal

The Center Director will submit an annual report to the members and the Vice President for Research (VPR) or appropriate entity as required. The annual report will summarize the activities of the Center for the past year, including financials, progress on goals, future plans or other topics as required by VPR.

The Center is authorized according to MTU policy. At the end of a term, the director, in consultation with the members, will seek renewal every five years following VPR guidelines.

3.10 Charter Amendments

Proposed changes to the Charter can be initiated by voting members of the ESC. Notice of proposed changes must be provided to members for review 14 days prior to the opening of voting. Voting will follow the procedures set out above except that changes to the Charter require a two-thirds majority of voting members.

4. Five (5) Year Strategic Plan

4.1 Mission

The mission of ESC is to advance knowledge through research on ecosystems.

4.2 Vision

ESC will be a productive, vibrant, and inclusive community of scholars at Michigan Tech who collaborate across disciplines to conduct basic research and help steward ecosystems in the anthropocene.

4.3 Guiding Principles/Core Value

- Research excellence and integrity
- Shared governance
- Diversity, equity, inclusion and respect
- Stewardship

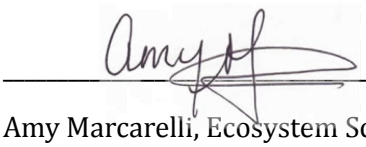
4.4 Goals and Actions

1. Foster a vibrant, and inclusive community of scholars who conduct research with relevance to ecosystems
    a. Support community-building programs among members (e.g., Coffee hour, Research Forum, DELS)
    b. Develop and help navigate access to research infrastructure
        i. Cost-share for advanced instrumentation for ecosystem research that is available for use by multiple members.
        ii. Sustainability initiatives to reduce redundancy of equipment on campus
    c. Encourage collaboration between ESC and other MTU research centers/institutes and facilities through MOUs, research hubs, collaborative proposals, and other opportunities.
    d. Participate in discussions internal and external to Michigan Tech to sustain research and build capacity related to our core values.
2. Enhance member efforts to acquire external funds for ecosystem research.
    a. Identify funding opportunities and help researchers develop externally funded research proposals, in partnership with Research Development and other groups at Michigan Tech.
    b. Support research by members across all career stages though graduate and undergraduate student mini-grants, seed/matching funds and grant-specific mentoring
    c. Identify and lead large, multi-institution, interdisciplinary proposals related to our mission and vision (e.g., climate change, stewardship, transdisciplinary research)
    d. Sustain and grow ESC staff to support pre-award activities and enhance post-award programming and effectiveness
3. Support and grow internal and external partnerships and capacity to achieve novel broader/research impacts
    a. Assist with collaborations among members to bring research to the public through education, outreach and community partnerships

b. Pursue external partnerships to improve graduate student research and training through internships, fellowships, etc.

c. Build visibility of ESC research external to Michigan Tech (social media, marketing, agency visits)

Approval Signatures



Amy Marcarelli, Ecosystem Science Center Director

Kathleen E Halvorsen

Kathy Halvorsen, Associate Vice President for Research Development

Version History

	Notes
September 2004	Initial adoption of the charter following establishment of the ESC.
Current (2022)	Updated and restructured to align with the Vice President for Research Office guidance.

Appendix C. Proposals Submitted

There was a total of 96 proposals submitted in 2022. Of those 63 proposals were awarded for a total of $3,116,583 in requested funds. Additionally, 25 proposals are still pending at the time of this report.

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
2002070P2	Awarded	Rodney Chimner	Monitoring Support for the Colombian Paramo Peatland Mapping Carbon Cycling and Restoration Project	$117,426
2107003P1	Awarded	Sigrid Resh	Continuing KISMA priority invasive species control and outreach with partners and community	$50,000
2107024P1	Awarded	Xinfeng Xie	Laboratory Comparison of Borates from Different Sources (2107)	$132,816
2107028P1	Awarded	Todd Ontl	Forest Owner Carbon and Climate Education Program (FOCCE)	$49,950
2107011P1	Awarded	Fengjing Liu	Determining Amounts of Precipitation and Groundwater Inputs to Lakes on the Chequamegon-Nicolet National Forest	$7,990
2107030P1	Awarded	Tao Liu	Water Scarcity in the Serbian Danube: Agricultural land use Change and irrigation	$141,434
2107032P1	Awarded	Xinfeng Xie	AWPA E26 Test of Eucalyptus OSB (2108)	$40,762
2107046P1	Awarded	Fengjing Liu	Ash Ecosystems Processes Across an EAB Infestation Gradient	$90,000
1808021P5	Awarded	John A. Vucetich	WOLF-MOOSE STUDY CATALOGING PROJECT - ISRO - Supplement to Proposal #1808021	$15,000
1905013P2	Awarded	Kathleen E. Halvorsen	Supplement: GCR: Michigan Community and Anishinaabe Renewable Energy Sovereignty (MICARES)	$237,466

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
2002057P2	Awarded	Andrew J. Storer	Isle Royal Institute Support	$5,000
1806039P6	Awarded	Christopher R. Webster	Riparian Modeling and Assessment	$10,000
2010050P2	Awarded	Todd Ontl	Massachusetts DCR Climate Forestry-Year 2	$34,998
2109037P1	Awarded	Xinfeng Xie	The effect of catastrophic water events on performance of hard maple flooring systems - Fastener holding capacity	$33,402
1806039P7	Awarded	Christopher R. Webster	Riparian Modeling and Assessment	$120,000
2109029P1	Awarded	Andrew J. Storer	FY22 McIntire Stennis Overall Program	$359,099
2109056P1	Awarded	Tara Bal	Impact of Earthworm Invasion on Maple Sugar Content and Tree Health	$8,000
2109057P1	Awarded	Kristin E. Brzeski	Assessing taxonomy of native remnant canids in the American southeast and habitat that support native genetics	$8,000
2109058P1	Awarded	Julia Burton	Silviculture on the basis of functional traits	$8,000
2109059P1	Awarded	Andrew J. Burton	Effects of Global Change Factors on Belowground Processes and Carbon Storage in Northern Hardwood Species	$8,000
2109060P1	Awarded	Victor Busov	Regulation of dormancy release and bud-break in trees	$8,000
2109061P1	Awarded	Molly A. Cavaleri	Investigating within canopy phenotypic plasticity to assess the acclimation potential of temperate and tropical tree species to climatic change	$8,000
2109062P1	Awarded	David J. Flaspohler	Improving the resiliency and sustainability of agroecosystems through improved understanding of bird ecosystem services and landscape pattern	$8,000
2109064P1	Awarded	Carsten Kuelheim	The genetic basis of climate adaptation in red oak	$8,000

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
2109065P1	Awarded	Fengjing Liu	Impact of Trees and Microtopography on Snow Distribution and Snowmelt Regime in Mixed Hardwood Forests of Northern Michigan	$8,000
2109066P1	Awarded	Tao Liu	Individual Tree Detection and Delineation using LiDAR Point Cloud and Aerial Images with Deep Learning Techniques	$8,000
2109067P1	Awarded	Mark Rudnicki	Enabling the Forest-based Circular Bioeconomy Through Valorization on Residuals	$8,000
2109068P1	Awarded	Steven Voelker	Development of Tree-Ring Growth and Stable Isotope Records For Reconstructing Forest Productivity and Lake Effect Snow in the Lake Superior Region	$8,000
2109069P1	Awarded	John A. Vucetich	Does deliberative democracy favor the conservation of controversial forest-dwelling species of wildlife?	$8,000
2109070P1	Awarded	Christopher R. Webster	A long-term investigation of winter foraging habitat selection and stand dynamics in relict eastern hemlock stand is the western Upper Peninsula of Michigan	$8,000
2109071P1	Awarded	Jared D. Wolfe	Integrating economically valuable wildlife management into silviculture practices in northern Michigan	$8,000
2109072P1	Awarded	Xinfeng Xie	Developing Lignocellulose-based Metamaterials for Broadband Microwave Absorption	$8,000
2109073P1	Awarded	Yinan Yuan	Functional Characterization of Drought Responsive Antisense Transcripts in Populus	$8,000
2007040P2	Awarded	Andrew J. Burton	Modeling Carbon Storage and Fluxes in Tidal Freshwater Forested Wetlands in Southeastern United States under Climate Change Sea Level	$22,500

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
			Rise and Resource Management	
2111004P1	Awarded	Sigrid Resh	Expanding KISMA's Reach Across Both Aquatic and Terrestrial Ecosystems	$60,000
2110061P1	Awarded	Xinfeng Xie	Field Exposure of Eucalyptus OSB Siding (2111)	$66,989
2111053P1	Awarded	Fengjing Liu	Understanding the Controls of Solute Transport by Streamflow Using Concentration-Discharge Relationship in the Upper Peninsula of Michigan	$4,000
1407022P10	Awarded	Amy M. Marcarelli	CAREER: Yin and yang - is there a balance between nitrogen fixation and denitrification in riverine ecosystems?	$14,937
1701050P4	Awarded	Andrew J. Burton	COVID supplement to: Collaborative Research: Impact of microbial and termite communities on transfer of decaying wood C to stable and protected mineral soil C pools	$33,115
2201012P1	Awarded	Xinfeng Xie	Zinc Borate Comparison Studies (2201)	$40,253
2003046P2	Awarded	Evan S. Kane	REU supplement to award 2031076: Title: Collaborative Research: Does tree encroachment with altered hydrology in peatlands accelerate or suppress decomposition?	$12,360
2201020P1	Awarded	Sarah R. Hoy	Isle Royale wolf-moose population monitoring	$37,000
2201024P1	Awarded	Xinfeng Xie	Maunawili Ground Contact Decay Test of Project KRD 21-026 (2202)	$45,175
2201010P1	Awarded	Sarah R. Hoy	Can near-infrared reflectance spectroscopy be used to monitor phytochemical traits of Balsam fir & chemically mediated interactions between fir climate and herbivory?	$8,000
2202031P1	Awarded	Julia Burton	Pushing the limits: role of functional and structural complexity in determining upper limits of carbon storage and sequestration in cool-temperate old	$15,000

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
			growth forest ecosystems	
2202010P1	Awarded	Xinfeng Xie	Ground Contact Decay and Depletion Test of Project KRD2011-E7 (1111) - 3	$40,000
2202011P1	Awarded	Xinfeng Xie	Maunawili Ground Contact Decay Test of Project KRD 15-013 (1508) - 2	$40,000
2202013P1	Awarded	Xinfeng Xie	Maunawili Ground Contact Decay Test of Project KRD 13-023 (1602) - 2	$40,000
1808021P6	Awarded	John A. Vucetich	Wolf Moose Study Collection Cataloging and Specimen Preservation	$30,000
2203033P1	Awarded	Xinfeng Xie	Modification to the Ground Proximity Termite Test of Project 6292 (2029)	$8,438
2204019P1	Awarded	Todd Ontl	Supporting climate-informed habitat restoration for biodiversity and carbon in southern Wisconsin	$49,998
2204008P1	Awarded	Xinfeng Xie	Subtropical Field Exposure of Experimental Roof System on An Outdoor Storage Shed	$48,329
2204029P1	Awarded	Xinfeng Xie	Laboratory Tests on Selected Properties of Experimental OSB Panels (2203)	$51,227
1511029P2	Awarded	Rodney Chimner	CNH-RCN: Andes Bofedales and Cattle: The Impacts of Changing Hydrology and Glacial Retreat on Community Livelihoods in Peru's Cordillera Blanca	$95,343
1907013P2	Awarded	Erika Hersch-Green	CAREER: Can material costs contribute to the structuring of biodiversity patterns from genomes and transcriptomes to multispecies communities?	$65,453
2204062P1	Awarded	Xinfeng Xie	Laboratory Decay Test on MCA Treated Wood (2204)	$4,092
2205003P1	Awarded	Sigrid Resh	AIS outreach and portable boat wash support for KISMA	$15,500

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
2205038P1	Awarded	Richelle L. Winkler	Social Vulnerability to Wildfire and Adaptive Capacity	$99,928
2205051P1	Awarded	Patricia R. Leopold	Northern Forest Climate Hub Support	$407,780
2104023P2	Awarded	Evan S. Kane	Belowground Ecosystem Ecologist	$65,000
2206021P1	Awarded		Decision support tools to sustain and increase soil carbon through forest management in the Northeast U.S.	$56,000
2206032P1	Awarded	Evan S. Kane	Response of forest and peatland ecosystems to environmental change: new continuation	$22,000
2206039P1	Awarded	Xinfeng Xie	Laboratory Decay Test of Wood Veneer Composites - 0622	$36,823
2007006P2	Closed	Rodney Chimner	Monitoring Supports for the Sustainable Wetlands Adaptation and Mitigation Program in South America	$227,341
2107009P1	Declined	Jared D. Wolfe	Riparian restoration on the lower reaches of the Pilgrim River	$109,246
2107001P1	Declined	Rodney Chimner	Collaborative Research: Limits to stablity and resilience in paramo peatlands: Exploring tipping points of carbon and water cycling in response to climate change	$479,407
2108014P1	Declined	Tao Liu	Mapping Drivers of Biodiversity: Ecosystem Functions and Food Webs	$572,142
2112042PP	Declined	Mark Rudnicki	Enabling the Adoption of Hardwoods in Mass Timber Buildings	$ -
2201007P1	Declined	Amy M. Marcarelli	MSA: Quantifying whole-stream denitrification and nitrogen fixation with integrated modeling of N2 and O2 fluxes	$300,000
2202003P1	Declined	Evan S. Kane	Estimating trace gas flux dynamics in boreal wetlands: linking remote sensing with long-term	$67,552

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
			field measurement data	
2204041P1	Declined	Tao Liu	Understanding Terrestrial Ecosystem Responses to Climate Change Across Multiple Environmental Conditions Through Machine Learning Enabled Model Data Integration	$149,993
2110062P1	Pending	Xinfeng Xie	AWPA E26 Test of Zinc Borate Treated Composite Trim (2111)	$44,645
2110063P1	Pending	Xinfeng Xie	Zinc Borate Comparison Studies (2110)	$40,253
2111062P1	Pending	Xinfeng Xie	Efficient Dying Processes of High-Quality Wood through Intelligent Desiccant Assisted Heat Pump System Innovations	$300,000
2111072P1	Pending	Evan S. Kane	Quantifying carbon storage and trace gas flux dynamics in boreal and subarctic wetland soils via remote sensing of wetland	$833,094
2112043P1	Pending	Jared D. Wolfe	Collaborative Research: LTREB: Forest Fragmentation and climate change impact bottom up processes that affect tropical avian diversity	$349,329
2201037P1	Pending	Andrew J. Burton	Team ORAU: TITLE REDACTED	$1,558,306
2201040P1	Pending	Xinfeng Xie	Increasing acceptance of northern hardwood lumber into cross laminated timber (CLT) by repurposing low-grade red maple	$247,790
2201055PP	Pending	Carsten Külheim	A systems approach to value-added biofuel feedstock from eucalyptus	$ -
2201056P1	Pending	Kristen Schmitt	Climate Adaptation Support for National Guard Project-Level Planning and Implementation	$23,819
2202012P1	Pending	Xinfeng Xie	AWPA E26 Test of Series 2007/HI Wood Preservatives (0911) - 5	$35,000
2202014P1	Pending	Xinfeng Xie	Effect of Manufacturing Variables on Termite Resistance of Aspen Flake Board (1511) - 3	$35,000

PROPOSAL #	STATUS	PRINCIPAL	PROPOSAL TITLE	REQUESTED $
2202015P1	Pending	Xinfeng Xie	AWPA E26 Test of Series 2016G/HI Wood Preservatives (1111) - 4	$35,000
2202016P1	Pending	Xinfeng Xie	Ground Proximity Decay Test of KRD Experimental Wood Preservatives (0511) - 4	$40,000
1608067P4	Pending	Rebecca G. Ong	Great Lakes Bioenergy Research Center	$749,999
2203027P1	Pending	Rebecca G. Ong	Grass Stem Design for Sustainable Biorefining	$915,870
2002057P3	Pending	Andrew J. Storer	Isle Royale Institute Support	$10,000
2204001P1	Pending	Julia Burton	Managing Forest Understories for Climate Change: Indigenous Cultural Ecosystem Services & Early-Seral Wildlife Habitat	$39,581
2204036P1	Pending	Todd Ontl	SitS: Improving forest management and soil health through sensor-enabled decision making	$841,009
2204052P1	Pending	Jared D. Wolfe	Development and implementation of management strategies to reduce White-nose Syndrome and increase bat survival in Michigan's abandoned mine hibernacula	$103,924
2205052P1	Pending	Tara Bal	Improving Forest Health Education: Filling a gap in Open-Access Resources	$8,000
2206036P1	Pending	Tao Liu	ECOSTRESS Applications to Forecasting and Understanding the Mechanisms of Forest Mortality in the Contiguous US	$466,982
2206013P1	Pending	Danielle N. Shannon	USDA Northern Forest Climate Hub Coordination	$296,029
2205024P1	Pending	Kristen Schmitt	Increasing Forest Service Capacity for Climate-Informed Project Development	$150,759
2109063P1	Pending WIP	Evan S. Kane	Incorporation of Historic Fire Regime Data in Lowland Conifer Forest Management in Northern Michigan	$8,000
1909093P3	Pending WIP	Kristin E. Brzeski	Monitoring Genetic Health of Isle Royale Wolves	$44,615

Appendix D. List of student research and travel awards for FY 22

Table D1: List of student travel awards in FY22, including student advisor and the name and location of the event attended. Each student received $750 to use as they chose towards travel and/or registration. A total of $12,645 was awarded for student travel in FY 22.

Student	Advisor and Department	Event and Location
Michael Arkwright	Tara Bal, CFRES	2022 SAF National Convention, Baltimore, MD
Chinmoyee Das	Andrew Burton, CFRES	Forest Products Society Int'l Conf, Madison, WI
Melanie Ottino	Kristin Brzeski and Carsten Küelheim, CFRES	The Wildlife Society Annual Conf, Spokane WA
Lulu Ferrer	Jared Wolfe and Kristin Brzeski, CFRES	Amer. Ornithological Society, San Juan, PR
Michelle Kelly	Amy Marcarelli, Bio Sci	Joint Aquatic Sciences Mtg, Grand Rapids MI
Kath Higdon (nee Schneider)	Tara Bal and Kristin Brzeski, CFRES	ESA/ESC/ESBC Joint Annual Mtg, Vancouver, BC
John C. McCall	Gord Patterson and Kristin Brzeski, Biol Sci/CFRES	Ecological Soc of Amer, Montreal, Quebec
Madalyn Tudor-Duncan	Molly Cavaleri, CFRES	Ecological Soc of Amer, Montreal, Quebec
Peng Quan	Xinfeng Xie, CFRES	Forest Products Society Int'l Conf, Madison, WI
Eileen Reeves	Andrew Burton, CFRES	Ecological Soc of Amer, Montreal, Quebec
Samuel Mensah Opoku	Andrew Burton, CFRES	Ecological Soc of Amer, Montreal, Quebec
Mattison Brady	Tara Bal, CFRES	2022 SAF National Convention, Baltimore, MD
Swapan Chakrabarty	Carsten Küelheim, CFRES	PEQG22 Population, Evolutionary, and Quantitative Genetics Conference, Pacific Grove, CA
Rob Tunison	Molly Cavaleri, CFRES	Ecological Soc of Amer, Montreal, Quebec
Abraham Stone	Tara Bal, CFRES	2022 Natural Resources Converence, Duluth, MN

Table D2: List of student research awards in FY22, including student advisor, project name and award amount. Undergraduate students can apply for up to $750, and graduate students can apply for up to $1,000 to use towards their research project. and the name and location of the event attended. Each student received $750 to use as they chose towards travel and/or registration. A total of $22,412 was awarded for student research awards in FY22.

Student	Advisor and Department	Project title	Award Amount
Jenna Brewer	J. Wolfe, K. Brzeski - CFRES	Northern cardinal's range expansion as a result of supplementary feeding	$750.00
Nathan Coleman	J Vucetich - CFRES	Lethal vs Non-Lethal? Comparing the cost of wolf-livestock conflict mitigation methods in an area of non-lethal mitigation and an area of lethal mitigation in Idaho	$1,000.00
Lulu Ferrer	J. Wolfe, K. Brzeski - CFRES	Forest structure and arthropod prey influence on mercury contamination in the terrestrial insectivorous bird, Carolina Wren (Thryothorus ludovicianus)	$1,000.00
Melanie Ottino	K. Brzeski, C. Kulheim, C. Webster - CFRES	Development of noninvasive fecal metabarcoding methodology for generalist herbivore in Upper Peninsula	$1,000.00
Emma Shedd	M. Cavaleri, A. Burton - CFRES	Root respiration acclimation in quercus rubra along a Midwest temperature gradient	$1,000.00
Zachary Solomon	N. Langston - Soc Sci	Can carbon offsets protect forests resources in the Keweenaw County?	$1,000.00
Reed Arneson	Y. Yuan - CFRES	Introducing An Artificial Sense-Antisense Reporter System to Arabidopsis thalinana	$1,000.00
Tiff Degroot	K. Brzeski - CFRES	Using environmentally-derived DNA to compare mammal community composition in tropical lowland forests	$1,000.00
Chris Hohnholt	C. Webster - CFRES	Efficacy comparison of two herbicides with different sites of action to control glossy buckthorn (Frangula alnus)	$717.00
Joanna Walitalo	M. Cavaleri - CFRES	Comparing Wood Species and	$1,000.00

Student	Advisor and Department	Project title	Award Amount
		Wood Preparation for Use in Pyrography	
Peng Quan	X. Xie - CFRES	Desulfurization of Kraft Lignin Using Hydrogen Peroxide	$1,000.00
Jasmine Terry-Shindelman	S. Hoy - CFRES	Can near-infrared reflectance spectroscopy be used as a rapid and cost-effective method of monitoring plant secondary metabolite profiles of Balsam fir	$1,000.00
Michelle Kelly	A. Marcarelli - Biol Sci	Quantifying whole-stream denitrification and nitrogen fixation with integrated modeling of N2 and O2 fluxes	$1,000.00
Sam Kurkowski	R. Chimner - CFRES	Mapping, Identification, and Conservation of Vernal Pool Characteristics at Voyagers National Parks in the Great Lakes Region	$1,000.00
John McCall	G. Paterson, K. Brzeski - Biol Sci/CFRES	Quantifying the genetic contributions of Buffalo Reef spawned fishes to Lake Superior fisheries	$1,000.00
Hailee Petosky	E. Hersch-Green - Biol Sci	Determining whether nutrient enrichments and plant genome size influences biodiversity patterns of insect communities	$945.00
Natalie Howard	C. Külheim - CFRES	Variance Components and Phenotypic Plasticity of Northern Red Oak (Quercus rubra) in a Replicated Common Garden Experiment	$750.00
Ryne Rutherford	D. Flaspohler - CFRES	Ecological and anthropogenic factors associated with the occurrence of southern disjunct fauna isolated in warm refugia	$1,000.00
Kath Schneider	T. Bal, K. Brzeski - CFRES	Examining Silviculture Impacts on Coleopteran Diets (Families Silphidae and Carabidae)	$1,000.00
Shelby Lane-Clark	T. Bal - CFRES	Bioturbation by Non-native Earthworms as a Potential Catalyst	$1,000.00

Student	Advisor and Department	Project title	Award Amount
		for Changes in Maple Sap Composition in Northern Hardwood Forests in the Great Lakes Region	
Abraham Stone	T. Bal, S. Resh - Biol Sci	Developing and Measuring Deployment of a Natural Myco-Biological Control In a More Liquid Medium	$750.00
Tessa Tormonen	K. Brzeski - Biol Sci	Using DNA Metabarcoding to Evaluate Resource Partitioning Among Two Sympatric Tilefish	$750.00
Swapan Chakrabarty	C. Külheim - CFRES	Genomic adaptation of two oak species in drought condition	$1,000.00
Ellie Connett	A. Marcarelli - Biol Sci	Heavy Metal Transfers by Aquatic Prey to Riparian Spiders in the Keweenaw Waterway	$750.00