

Submission date: January 31, 2020

Program/s in this review: MS BIOS Biological Sciences

Specialized accrediting agency (if applicable): Not applicable

Campuses where the program is delivered: Anchorage

Members of the program review committee:

- Khrys Duddleston, Professor and Director of Biological Sciences, Anchorage Campus
- Jonathan Stecyk, Associate Professor of Biological Sciences, Anchorage Campus

1. Centrality of Program Mission and Supporting Role (700 words or less)

Relevancy of the program:

The MS BIOS fundamentally aligns with the UAA, CAS and Dept. of Biological Sciences missions, and the UAA 2020 strategic plan. The program *disseminates knowledge efficiently and effectively* (Biological Sciences mission) via *the discovery of knowledge through teaching and research* (UAA mission), and *betters Alaska and beyond* (CAS mission) by successfully training students for future employment (i.e., workforce development). We train developing life scientists to discover new knowledge through rigorous scientific experimentation and critical reasoning, and prepare students for careers requiring advanced technical and scientific skills. Our students are competitive for positions in the federal, state, and private sectors, and for more advanced training at professional and academic institutions. The program also supports the Department's undergraduate programs via instruction (GTAs in undergraduate labs), and near-peer mentoring of undergraduates in research labs. The MS program is critical to the Department's research emphasis in Biomedical and Ecosystem Health Sciences through its contribution to faculty research productivity, which in turn informs graduate and undergraduate curricula, and enables faculty to engage students in the highest impact teaching practice in the sciences, research, through which students learn via the creation of new knowledge.

Role the program plays in supporting other academic programs

Graduate students from other programs enroll in core MS BIOS courses (BIOL A601, A605; e.g. Anthropology, Geological Sciences, WWAMI, Education, Economics, and Engineering). Our graduate faculty also serve on graduate committees outside the department. We are also home to 7 INDS MS students. Additionally, the MS BIOS supports departmental undergraduate programs (BA/BS BIOS; BS NSCI) via GTA activities and near-peer mentorship in research laboratories. Additionally, MS BIOS students recently implemented a graduate-undergraduate mentoring program to provide education and career mentorship to BIOS and NSCI undergraduates.

Partnerships with agencies, businesses, or organizations

The Department maintains research and educational partnerships with state and federal agencies (e.g. ADF&G, AKDEC, CDC, State Public Health Labs, US DHS, US FS, NOAA, USGS, Alaska Science Center and others) through Cooperative Agreements. MS BIOS students are often supported by these and other agencies to conduct their research. Agency employees serve on graduate committees, students gain employment following graduation.

Specific workforce development and employment opportunities relevant to the program

The individual, diverse graduate research projects fall within the Biomedical and Ecosystem Health Sciences and meet the needs of the state and nation by successfully training students for future research and employment. Our research-based MS degree emphasizes learning through creation of new knowledge, which develops creativity, problem solving skills, and writing and presentation skills; all skills valued by employers. MS BIOS graduates have been 100% successful in obtaining professional positions in biologically relevant fields (tracking since 2011). Approximately 1/3rd go on to jobs with state and/or federal agencies, 1/3rd to other research/professional careers and 1/3rd remain affiliated with UAA post-graduation (e.g. research technicians).

Sources of extramural support and funding

Research funding to support the MS program comes primarily through grants awarded to faculty, which provide tuition and research funds. External funding comes from numerous federal and state agencies (NSF; NIH; ADF&G; others) and private non-profits. From FY2013 - FY2018, extramural grants totaled ~\$21M (CAS Biology org code 12099), averaging 7-12 active grants/y (average FY budget ~\$1.8M). Currently, research faculty (n = 13) are managing ~\$9.2M in active awards (~\$5.8M DC; ~\$3.1M ICR; org code 12099). External support also comes from graduate research fellowships (stipends and tuition). Indeed, 62% of our graduate students (AY2018-2019) were supported by GTAs or extramural funds (fellowships; research assistantships). Thus, students are state economic multipliers, their employment contributing directly to the Alaskan economy.

High demand job designation for the program

The M.S. BIOS program, with its strength in Biomedical and Ecosystem Health Sciences research, helps fulfil the diverse employment needs of Alaska and beyond. All graduates since 2011 have gained employment in science research, or related fields, or are continuing their graduate research at the Ph.D. level. Employment opportunities for our graduate students remain strong with no indication of market saturation.

2. Program Demand (including service to other programs), Efficiency, and Productivity (7 year trend; 1400 words or less) *NOTE: We refer to table numbers provided by the Dean, but they are not discussed in the order provided*

Demand for the MS BIOS degree is strong and consistent, as research active faculty in the department directly involve students in their research programs. Over the past seven years, an average of 27 students/year have been enrolled in the program (Table 3). Currently, we have 26 MS students. An additional 3 UAF PhD students are supervised by UAA Biological Sciences faculty, spending nearly all of their time at UAA. Instructional productivity is also strong and consistent. Student credit hours averaged 317 over the past 7 years (Table 7).

From 2013 to 2015/2016, there was a decline in the number of graduate students in the program and/or student credit hour production (Tables 3 and 7). This may have been due in part to the number of extramural awards our research-active faculty had during that time, because faculty must have funding in-hand to support the student's research prior to accepting a student into the program (this program requirement ensures students can move through their programs efficiently and produce a quality thesis). The more significant factor was likely that the number of faculty with research in their workloads declined over those years due to faculty departures. Since FY10 the department has had a net loss of 10 faculty, the majority of whom were tripartite research faculty (16 losses [via retirement, move to CoH, left UAA]; 6 hires). This was further compounded by a decrease in the number of students that individual faculty members were willing/able to accept into their labs, which was likely a reflection of the burden of increased teaching and service loads on remaining faculty. The decline in the number of research-active faculty able to accept students, and the number of students per faculty are further reflected in the number of degrees awarded (Table 1). Graduation numbers decreased from a peak of 13 in 2014. Prior, the trend was reversed (graduates were 3 in 2010, 4 in 2011, 6 in 2012, and 7 in 2013).

To reverse these trends and increase program vigor, we implemented a number of programmatic changes to encourage faculty (particularly junior faculty) to accept more students. These include:

- a. Recruiting TA-ships: the department offers several 'recruiting TA'ships' each year. These two-year TAships provide stipend and tuition support for students and are designed to allow faculty to recruit new students to the program, even if they don't have a large pool of resources (funding for the project must be in hand). These are prioritized to junior faculty.
- b. We continually encourage our students to apply for (and make them aware of) additional sources of external funds for travel and research support, as too few of our students were taking advantage of these opportunities (or reporting their use). Additional student-generated support for research activities will allow faculty to bring more students into their laboratories.
- c. We altered the graduate supervisory policy such that the primary graduate student committee advisor can be any UAA faculty (so long as two committee members are from Biological Sciences). This has enabled students to enroll in our MS program instead of the Interdisciplinary MS degree where appropriate.

The improvements to the program appear to be working. The number of MS students in the program has increased (from 22 in 2015 to 26 in 2019; Table 3), as has student credit hour production (from 277 in 2016 to 386 in 2019; Table 7). Concurrently, SCH/FTEF, Enrollment/FTEF, FTES/FTEF, average class size, and Tuition Revenue/SCH have continuously increased (Tables 8-11 and 13), whereas Cost/SCH has continuously decreased (Table 12). Specifically, SCH/FTEF (73.8 in 2014; 155.4 in 2019), Enrollment/FTEF (29.3 in 2014; 49.7 in 2019), and average class size (2.3 in 2014; 5.3 in 2019) have approximately doubled, and Tuition Revenue/SCH (402.7 in 2015; 489.0 in 2019) has increased by 21%. Thus, Cost/SCH has decreased by 35% (2375.2 in 2015; 1535.4 in 2019).

The number of degrees awarded remains lower (2-4 per year) than the peak of 13 that occurred in 2014 (Table 1). As noted above, this may be due in part to the decrease in total numbers of students. It likely also reflects that students are taking longer to complete their degree. Indeed, credits, semester and years per degree has increased since 2016 (Table 2; note: 2019 was anomalously high due to personal circumstances of a graduate). Although a majority of graduate students are supported by assistantships, some students complete their degrees while working outside employment, which increases time to completion. Important however, is that students are neither dropping out of the program nor becoming inactive. Retention of admitted students is high and almost all students complete their degree. Over the past 5 years, only 2 students have left the program prior to completion. In addition, enrolled students are highly productive, as indicated by the number of publications in peer-reviewed journals and presentations at state, national and international conferences resulting from their work (*detailed below*). These metrics of student success, coupled with the 100% success rate of students finding employment upon graduation or going onto to additional advanced degrees, indicate that the program is producing high quality scientific research in Biomedical and Ecosystem Health Sciences, is functioning efficiently, and succeeding in workforce development for the State and beyond.

From summer 2014 through fall 2018 (201402-201803), 93% of Biological Sciences total faculty pay from unrestricted funds (\$12,563,632) was covered by tuition revenue to CAS (total tuition*0.80 = tuition to CAS: \$14,666,816*0.80 = \$11,733,453 [BIOL/MBIO courses taught by CAS faculty on main UAA campus] from IR Course Tuition by Faculty Total Pay accessed January 28, 2020). Faculty in Biological Sciences contribute to departmental instruction at all levels. The majority of our graduate courses are stacked with undergraduate courses and therefore do not incur separate instructional costs. In addition, graduate students enroll in directed research (A698) and thesis (A699) credits, generating ~\$410K in tuition over the aforementioned timeframe (~\$45K/semester exclusive of summer) for no instructional cost (faculty are not given workload credit for these courses). Research in the biological sciences does not adhere to the human construct of the "academic year"; thus, graduate research continues through the summer months (as is true for the majority of thesis research-based graduate degrees in the sciences regardless of institution). Faculty advisors must continue supervision and mentorship during the summer, and their summer salaries are paid from restricted funds/external research grants.

As was noted in the most recent accreditation review by the NWCCU, graduate programs at UAA need to decrease stacked courses. Budget constraints on resources preclude us from increasing the number of graduate-only course offerings at this time; however, we strive to ensure our stacked graduate courses are truly advanced, through the development of specific graduate level SLOs, including those supporting the development of leadership and mentorship skills through guided group work with undergraduate near-peers. Additionally, our graduate students also enroll in some graduate courses at UAF, and vice versa, and communication and coordination among our programs regarding distance delivery of courses is increasing.

3. Program Quality, Improvement and Student Success (1500 words or less)

Specialized accreditation process and status

Not Applicable

Currency of the program

Over the past few years, we have made improvements to the program in two main areas: First, we instituted three required courses for all graduate students that emphasize experimental design and scientific thought (BIOL A601), academic, scientific, and presentation skills (BIOL A605), and quantitative and analytical skills (BIOL A606). Students are encouraged to complete BIOL A601 and A605 in their first fall semester, and this has helped students move into their

graduate research in a timely and professional way. It also facilitated the creation of graduate student cohorts, which have helped with program morale and student cohesiveness.

Currently, the department is revising the MS BIOS program to include a non-thesis, professional MS option to enhance workforce development. As noted above, the MS program has close ties to a number of state and federal agencies, and demand for such an option is high, in particular for fulltime employees who wish to earn an advanced degree while working. A secondary benefit of the non-thesis option is increased SCH production and tuition revenue.

Innovative program design

The research experiences and workforce development-training that students obtain when conducting their graduate research is distinctive. To enter the program, students must submit a letter of support from a faculty member interested in serving as their graduate advisor and who has extramural funds available to support the student's research. Thus, ultimately, students graduate with MS degrees tailored to their personal research interests and career aspirations.

In order to grow student enrollment in the program and to streamline research opportunities, the requirements for graduate study committee composition were modified in AY2018-2019. Now, the primary research advisor can be from outside Biological Sciences so long as they are a full-time UAA faculty member and the two remaining committee members are from Biological Sciences. This has facilitated expansion of collaborative research projects among faculty across disciplines (e.g., with Chemistry, Geography and Environmental Studies), and has enabled students to enroll in our MS program when appropriate, rather than the Interdisciplinary MS degree.

Availability and indications of quality of distance offerings

Many UAA Biological Sciences faculty are affiliates of UAF departments (e.g. Biology and Wildlife; Biochemistry and Neuroscience). As such, they regularly serve on the graduate committees of UAF students, and through collaborative agreements, are able to serve as primary research advisor to UAF PhD students. There are currently three UAF PhD students who live in Anchorage, are supervised by UAA Biological Sciences faculty, take UAA courses and assist in mentoring UAA undergraduates in our research labs.

Some UAA BIOL graduate courses are offered distance, either synchronously or asynchronously (e.g. BIOL A655 Advanced Bioinformatics; BIOL A677 Advanced Tundra and Taiga Ecosystems; BIOL A669 Advanced Arctic Environmental Security; BIOL A663 Advanced Molecular Biology of Cancer). Students across Alaska, the US and the world have enrolled. We will continue to increase the number of upper level/graduate courses delivered by distance where appropriate.

Program student learning outcomes (SLOs) assessment

The MS in Biological Sciences has four student learning outcomes.

The successful candidate for the MS degree in Biological Sciences will

1. Have a working knowledge of the fundamental concepts of biology across a broad range of fields, and have a demonstrated mastery of at least one focus area within biology.
2. Have a working knowledge of the principles of the scientific method, of the methods and technology of biological research, and of appropriate quantitative methods for the analysis of scientific data.
3. Be capable of writing a publishable scientific paper, and presenting research findings at scientific conferences.
4. Be prepared for a career in biological sciences, and/or able to pursue more advanced research opportunities.

The first two SLOs are assessed through coursework and completion of a thesis research project. Student progress towards these SLOs is assessed yearly via a) approval of a thesis research proposal by the end of year one in the program (i.e., second academic semester) and yearly committee meetings. All students must pass an oral defense of their thesis at the end of the degree program. AY 2018-2019 saw 2 MS students graduate (Table 1). This number is on par with historical numbers (3-4 in AY 2009 and AY 2010), but lower than when departmental faculty numbers were at their peak (6 in AY 2016, 13 in AY 2014, 7 in 2013). The lower number of students completing their degrees is likely due to both the smaller program size in the past couple of years, and a few students taking longer than they had originally planned to complete

their degree. The course pass rate has been consistently high (avg. 75.6%) and the D, F, and withdrawal rate extremely low (avg. 1.9%; Table 4).

The third SLO is assessed by tracking data on student peer-reviewed scientific publications and presentations at local, national, and international meetings. These metrics track student writing, presentation, and synthesis ability, as well as the quality of their science. In the past 7 academic years, graduate students were authors on 111 papers and presented 271 talks or posters at domestic and international scientific conferences or other venues.

The fourth SLO reflects workforce development and is tracked by exit and alumni surveys. The MS program is extremely successful in training students for future employment/research endeavors. As highlighted above, our MS program graduate have succeeded at a 100% rate in obtaining professional positions in biologically relevant fields (for the graduated students we could track since 2011).

How well is the program doing on Student Success and how is student success facilitated

The MS BIOS program, with its strength in Biomedical and Ecosystem Health Sciences research, is by all metrics doing extremely well in terms of student success. Students are not withdrawing from the degree, enrollment in the program is increasing and the number of papers published and research presentations by graduate students is concurrently increasing. We expect that higher graduation rates will follow. Most importantly, the program boasts a 100% success rate in workforce development. For the graduated students we could track since 2011, all have obtained professional positions in biomedical or ecosystem health fields.

Student Success has also been enabled by program administration changes over the past few years. We have

- i. significantly refined methods to track student progress towards the SLOs. Blackboard was being used as the repository for students to maintain their records/paperwork up to date, as well as all faculty to review the files as necessary, and in AY 2017-18 an Excel database was constructed to aid in tracking student paperwork. However, Blackboard is overly cumbersome for this purpose, especially with regular Blackboard updates and purging of old shells). In addition, continuous revision of the Excel tracking file was cumbersome (especially in the event of staff vacancies). To rectify these problems, in AY 2018-2019 we planned, developed and commenced transition to an in-house built and Google-powered student tracking system that feeds data from Banner and multiple other sources. We also planned, developed and constructed a new Graduate Affairs Academic support website and commenced the implementation of the submission of required forms and progress reports using DocuSign PowerForms through the website. The newly implemented student tracking mechanisms will be continually assessed and refined in future years and overall, provides the department and the college with a more accurate understanding of the success of our program. *NOTE: Unending thanks go to our amazing MNS Hub Staff for their hard work putting this together, in particular M.D.-J. and G.S. As a testament to the value of these changes, M.D.-J. has been asked to present this system to others across campus.*
- ii. established new guidelines for faculty mentors, and we present these and student expectations to faculty and students in an annual seminar obligatory for all graduate students and graduate student supervisors. We have also clarified our internal working documents pertaining to the acceptance of students into the program, the application for teaching assistant positions and recruitment TA-ship duration.

Student accomplishments.

Over the review period, MS BIOL students have been first or co-author of 111 peer-reviewed manuscripts. They have also been first/presenting or co-author on 271 presentations at local, domestic and international scientific conferences. As noted previously, MS BIOS graduates go on to gainful employment or further advanced degrees. In the last four years, three graduates have entered PhD programs (Duke, UC Riverside, UAF), and another is pursuing a second master's degree. Eleven graduates have jobs with agencies (NOAA, USFWS, USFS, WA State Div. Nat. Resources) or other state or private sector employers (Systems Biology Institute; Alaska SeaLife Center, Oregon Pacific Area Health Education Center, Polar Field Services, Alaska Premier Health, Fisheye Consulting). Two graduates are research technicians at UAA. Lastly, during the period under review, two MS BIOS graduate students received graduate research fellowships from the National Science Foundation. These are highly competitive and prestigious fellowships awarded each year to the most promising graduate students across the country, and are a reflection of the quality of our graduate students and program.

4. Program Duplication / Distinctiveness (300 words or less)

Our program does not duplicate others in University of Alaska Statewide System. Any apparent duplication is in name only. In fact, each student's MS degree is distinct because each thesis research project is unique, each graduate study plan is unique, and each individual students' scientific interests and career aspirations are unique. Thus, the research experiences and workforce development training that each student obtains when conducting their research-based MS thesis in the Biomedical or Ecosystem Health Sciences at UAA is distinctive.

According to data obtained from UAA Institutional Research (Official Student Demographic Closing), the number of Biology MS majors at UAF between fall 2015 and spring 2019 ranged from 22 to 31. Thus, the programs on both campuses are the same size. Faculty research agendas at UAA and UAF are not duplicative, and the unique research programs of the faculty support individualized theses research on both campuses. Of our current UAA graduate students, nearly 50% are former UAA BIOS or NSCI alumni, a trend that is common among our MS BIOS student body, reflecting the place-based nature of UAA students. There is clearly demand for and strength to retain MS Degrees in Biological Sciences at both UAA and UAF.

Further support for the uniqueness of thesis-based graduate research projects is that UAA Department of Biological Sciences faculty routinely mentor UAF PhD students studying/conducting their thesis research at UAA. Indeed, as a consequence of unique faculty research programs, three UAF Ph.D. students are primarily supervised by UAA Department of Biological Sciences faculty. In addition to unique individual research projects, unique course offerings on both campuses have resulted in UAF graduate students enroll in distance delivered UAA courses and vice-versa.

5. Summary Analysis (500 words or less)

The MS BIOS program excels in workforce development and our graduate students are well-prepared for public and private sector jobs and continuation of their education in doctoral and professional programs. All of the students that have graduated from the program since 2011 have gained employment in science research or related fields, or are continuing their graduate research at the Ph.D. level. Research productivity, as evidenced by number of student-authored publications in peer-reviewed journals and presentations at state, national and international scientific conferences has increased in recent years. In addition, support for the graduate program by the MNS administrative core has led to improvements in paperwork and student tracking and have helped students remain on target and in good standing through their degree.

Our graduate program is integral to both the NSCI and BIOS undergraduate degrees offered by Biological Sciences. MS graduates work under the mentorship of faculty and ultimately publish their work in peer-reviewed journals. The publications a) expand the body of scientific knowledge, b) contribute to the students' future success, and c) contribute to faculty productivity. The latter enhances faculty competitiveness for extramural funds to maintain and grow research programs, which in turn provides opportunities for future graduate and undergraduate students to engage in authentic research experiences and learn via the creation of new knowledge. Faculty research programs inform our teaching and curricula at all levels, ensuring relevance and currency of the curriculum.

Declining university funding, departure of faculty and increasing competition for extramural support from state and federal agencies pose challenges for the graduate program in Biological Sciences. Maintaining cutting-edge laboratory facilities and equipment is critical to support and grow a competitive research faculty and to maintain and grow the graduate program. Growth and support of our graduate program is integral to the success of faculty in the department and to the department's undergraduate programs. Without a strong graduate program, recruiting and retaining faculty will be more difficult and existing faculty will leave. The subsequent decline will result in loss of external research dollars, a loss of currency of the undergraduate curricula, and significantly reduced opportunities for undergraduate research. Our graduate students work directly with undergraduate researchers and in doing so a) gain invaluable academic and professional skills, such as student mentorship and supervision and b) contribute to the delivery of high-impact teaching practice in our undergraduate programs. From the 2011 spring semester through to the 2019 summer semester, departmental faculty mentored 420 BIOL 498 Individual Research students (1,101 student credit hours). These numbers underestimate the number of students impacted by faculty research and our graduate program (via near-peer mentorship), as undergraduates also work in faculty labs as paid student research assistants.

The UAA MS BIOS program is worthy of investment for growth. The basis for and most fundamental component of, research-based graduate degrees is the individual authentic student research project, which is only available to students through the individual faculty research programs. Faculty research needs to be valued and supported, with investment in research faculty lines.