



The BEACON

News from The Coalition for Excellence in Science and Math Education

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PRESIDENT'S MESSAGE

The Challenges of Teaching

Terry Dunbar

At our annual meeting in June, I asked for a show of hands of those attending who are teachers. Approximately two thirds of the audience was teachers! I recognized several of them, and they included elementary, middle school, and high school teachers. I am extremely pleased that we have that many teachers who are members of CESE and find it valuable to attend the annual meeting. It tells me that they share our values and want to help us accomplish our goals, including doing what we can to improve not just math and science education, but education in general. They approve of our successful efforts to keep creationist nonsense out of the state science standards. They share a concern about the scientific literacy of the public. They got a chance to hear an enjoyable and informative talk about the periodic table from our speaker, Sam Kean, author of [The Disappearing Spoon](#). Sam took questions from the audience after the talk. He was peppered with questions from teachers and non-teachers in the audience.

The presence of so many teachers made me think about the challenges they face. When I began teaching in 1976, the expectations for teachers were different from those laid on teachers today. Societal expectations for public education seem to get ramped up with every generation, and the trend continues. International comparisons rightly raise anxiety levels, and result in a greater focus on public schools.

In the last 30 or 40 years the model of teaching and learning has changed. While there were experiments with modular classrooms and team teaching back in the 1970s, the norm was a traditional classroom. Middle

school and high school teachers stood in the front of the room and lectured to students who sat in rows. Students were expected to take notes and not talk to one another. The teacher was the “sage on the stage.” Some teachers taught from college notes that yellowed a little more with age each year.

What incoming teachers are taught now is quite different. The teacher as “sage on the stage” has given way to the role of “guide on the side”. While there are still traditional classrooms, more teachers than ever are having students work in groups to solve problems, learn from each other, and prepare posters, presentations, etc. There are still lots of tests, but now it isn't just students who fail!

How teachers work with other faculty has changed, too. While once it was not unusual to stay in one's classroom all day and rarely see another adult, now teachers are expected to work with other teachers as part of committees, professional learning communities, and other projects. Instructional coaches in many schools visit classrooms regularly and work with everyone from struggling teachers to master teachers who simply wish to improve their craft, and talk about it with someone knowledgeable. It all adds up to more work for teachers. Ask any teacher if his or her work-day ends with the last bell of the day.

Teachers are not alone in facing greater responsibilities. Americans in all professions have higher expectations than ever. According to the U.S. Bureau of

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Labor Statistics, the average productivity per American worker has increased 400% since 1950. Higher expectations for teachers include the faculty work mentioned above, as well as responsibility for professional development, not all of it remunerated. Every teacher in the Albuquerque Public Schools is required to take a course on teaching LEP (limited English proficiency) students as a condition of employment. The three-tiered licensure program requires all New Mexico teachers to submit a PDD (Professional Development Dossier) in order to advance to higher tiers. This involves documentation of classroom experiences.

There is more data-based decision making than ever before as NCLB has forced districts and schools to confront the inevitable comparisons that come with public attention to standardized test scores. Teachers are being asked to track student progress as never before. Accountability is everywhere you look.

And we in the teaching profession are about to enter a new era of accountability as the method of evaluating teachers in New Mexico changes. Recently when New Mexico Education Secretary-designate Hanna Skandera was interviewed on a morning talk show, she was asked about teacher evaluation. She explained that in the past principals have been asked to simply indicate if teachers were competent or not. A very high percentage of teachers had been evaluated as competent. With nearly everyone scored as competent, the data wasn't useful to distinguish good teaching from bad teaching. In the future, she said, teachers will be evaluated on a range of criteria so that there will not be a simple up or down determination of competency. A committee has been appointed to establish those criteria and develop a system of implementation.

As Secretary-Designate Skandera spoke, I listened closely to hear evidence that she is aware of what CESE members and others have been telling her about education in New Mexico. I found that evidence! She mentioned several times that test score results by themselves can not be used to compare schools or teachers. Demographics must be considered, too.

As of this writing, CESE members have presented this specific concept (tailored to New Mexico) to the Legislative Education Study Committee (LESC), refined it, and are preparing to present it to the Public Education Committee (PED) as soon as it can be scheduled. In fact, we believe that the original idea that the Secretary Designate mentioned fits in very well with the excellent statistical work that Walt Murfin has put together, of which the Secretary Designate received a preliminary copy. Please read a short account of the LESCE meeting and content of the concept later in the newsletter. CESE members, we are having an influence. Whether you are a teacher, scientist, engineer, or from some other background, rest assured that our voice is being heard. I thank you for your continued support for our organization.

Terry Dunbar
President CESE

Finally, a Real Shot at Improving Our New Mexico Schools

Kim Johnson

During the last New Mexico legislative session, a bill was passed called the A-B-C-D-F Schools Rating Act (A-B-C-D-F Act). No one was very sure of how this act could be used to actually improve schools in New Mexico after its first reading. But our CESE statistician, Walt Murfin, saw it as a vehicle that could be used to effect real educational change, based on the near-decade of work that he had done, beginning with Marshall Berman's, data needs as a member of the former NM State Board of Education.

Briefly, Walt's work uses accepted mathematical methods to derive a way to fairly account for and remove the effects of those demographics that are correlated with performance. The A-B-C-D-F Act is designed to grade schools based on a combination of performance variables, including the individual schools' NMSBA scores (New Mexico Standards Based Assessment), school growth in performance, and improvement of the lowest performing students. These are the scores from the very long, intensive tests that are taken by every school for various grades in reading and math. The tests are based on the New Mexico Public Education Department Standards for the core subjects of reading and math. The results of these tests are used to determine Annual Yearly Progress (AYP) as provided by the No Child Left Behind (NCLB) federal statute that is about seven years old. (I do apologize about all of the acronyms, but some readers may not be familiar with their source or with their meanings.) The A-B-C-D-F Act does not specify how the various performance measures should be combined. The CESE method completely eliminates the need for assigning some personal guesses about relative importance. All of the subjectivity in weighting the measures is removed.

The NCLB act was a bipartisan law enacted by Congress. It required that all states (unless they opted out, including opting out of the attendant federal funds) would have to meet a set of performance standards determined by the states. The performance level would progressively become more difficult, until the year 2014. At that time all states were to have met the full progress requirements such that essentially all students were performing at a proficient level.

Of course, different states set their start points and "yearly progress" at different points and rates. New Mexico set the "proficient" level by a defensible process, and it is more realistic than the levels set by many other states. It seemed that everyone but Congress was aware that not every student would be able to perform

at the equivalent of a "C" or better grade, no matter how long it took. (Proficient may be different than a "C" grade, but for the sake of this discussion, we presume that a C is proficient.) And sure enough, that is the case. The AYP, as proposed, simply guaranteed that every state school would eventually fail or else cheat. Cheating is not a nice word, but it is sometimes the only way to make it appear that essentially all students are performing at average or above – an impossible state of affairs.

Here enters the New Mexico A-B-C-D-F Act. It seems that some in Washington DC actually realized what many people had been telling them – AYP was an impossible goal. The rules are changing. The A-B-C-D-F act was ready made to replace AYP—as long as it is implemented with a defensible, traceable, and fair methodology. And here is where CESE enters with Walt Murfin's ceaseless work over the last decade or more.

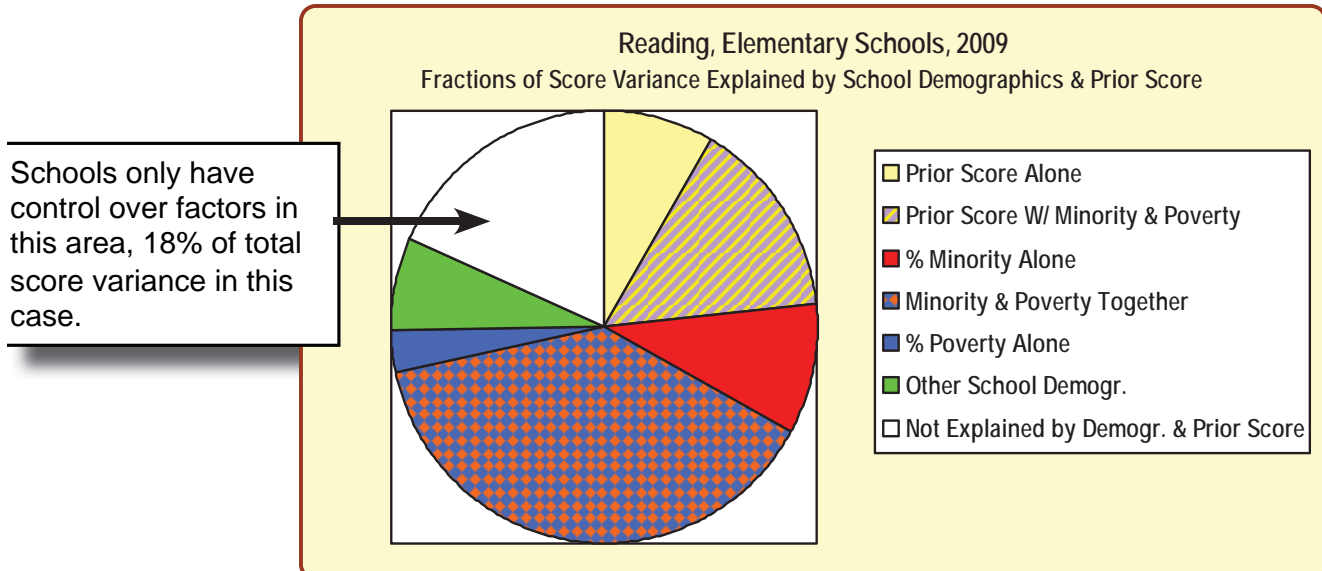
Walt has derived a method that allows for the removal of the "Demographic Effects" from school performance. Consider what goes into "demographics:" ethnicity, poverty level, English speaking ability, and a number of other things. When you very carefully do the math, you can correlate the average performance levels of all schools with their combined demographics. The high and low ends of the demographic scales may be labeled as "Advantaged Demographics" and "Disadvantaged Demographics." After looking at a set of schools – say all high schools in the state – one can plot the schools' performance test results against a predicted set of results based solely on demographics. Using growth and past performance to grade schools does remove some of the demographic effects, but is not equivalent to the more direct method that Walt developed. Most demographic effects are indeed removed by the "Value Added" method in states with less ethnic and economic diversity than ours. But that is not the case in New Mexico. Walt's method removes them directly and completely in every case. We are attempting to work with the people who push the "Value Added Models" and will report progress in the future on that front. All of this is, of course, more complicated than this simple description.

We have created a briefing on this. It was presented to the Legislative Education Study Committee (LESC) at the end of August. We revised it somewhat based on their questions and also to make points more understandable. We are attempting to present this briefing to Secretary Designate Skandera and the PED and others who have expressed interest. In fact, Secretary Designate Skandera has already seen a copy of the briefing, but without the full verbal explanation, and she may not be aware of all the nuances.

The key points of the briefing are that, as a primary goal, we believe that this method can be used to grade schools in a way that is fair and defensible—fundamental to the probable requirements of the US Department of Education, presuming this is an acceptable alternative to the current AYP. Additionally, and perhaps even more importantly, the data gleaned from this method can be used to look at those schools that are significantly outperform-

long way to go to put it into practice. As many of us have said, it seems that everyone has a silver bullet to improve schools or a magic reason why a specific school is not performing well. We know that many of these reasons and bullets simply are not important (some may be, too), but that in New Mexico no one has actually gone out and looked as we propose to find out what the real conditions are that lead to high performance regardless of the demographic status.

myth that poverty is the fundamental “cause” of poor school performance, is the very obvious fact that the schools have only a small impact on performance, as denoted by the white slice. This impact can vary between about 10% to less than 50%, depending on the core subject, schools, and so forth. And another item is worth noting: the prior performance has an effect on the score as well. The schools cannot change prior performance, and the prior performance and school



ing what is predicted for them to determine what they are doing differently from other schools. The outperforming schools should act as models in a given demographic index range to find out how to do it better! Then we can apply those methods to the lower performing schools in the same demographic range. This will result in raising the performance of the lower performing schools and closing the performance gap that is frequently discussed. It should also pressure the higher performing, advantaged demographic schools to perform better, too. We know this is possible, because we have the data that already shows some of the disadvantaged demographic schools outperforming the more advantaged schools by a significant margin.

This all sounds great, but there is a

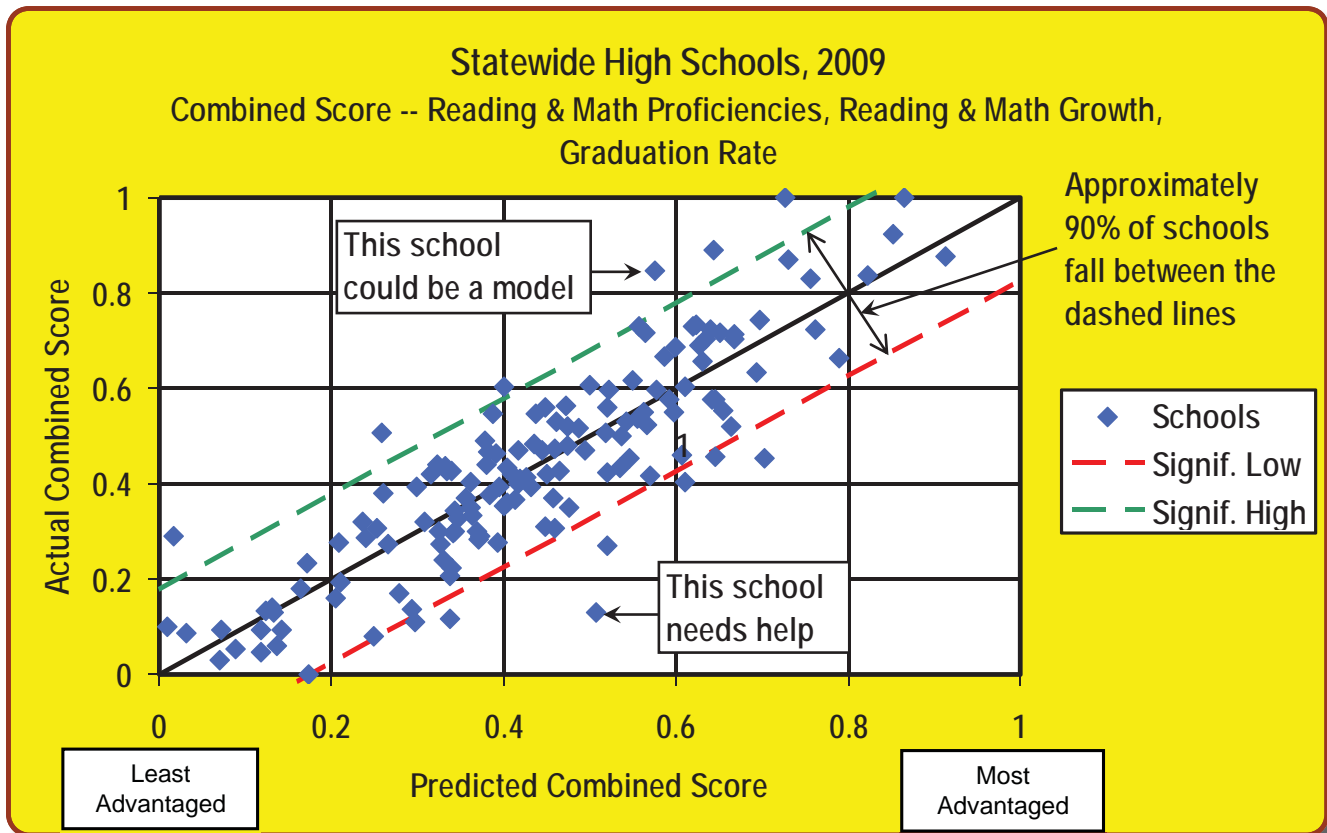
Anyone reading this and not familiar with the method addressed here will probably benefit from a very brief description with a couple of figures used in the briefing we are circulating. So first, let us look at a pie chart that shows how one set of school performance correlates with those demographics.

Note that, for this example of elementary reading from 2009, the schools have very little of their performance scores determined by the school itself. In fact, the largest, single explanatory factor is the combination of minority and poverty, not simply poverty as most people we encounter seem to believe. There are a number of items that can be discussed in this and similar charts, but probably more important than dispelling the

demographics together are completely beyond the control of the school in the current year. We have found that the schools’ average demographics affect every ethnic and economic group, and can be more important than the demographics of individual students.

Now, let us look at another informative chart. This chart shows demographically predicted versus actual combined scores for New Mexico high schools. Note that the trend is quite clear—the least advantaged demographic schools score at a much lower proficiency than do the most advantaged. This would seem to be intuitive, yet this is now defensible and shows specific data that can help schools.

How does it help with grading schools for performance? It shows



which schools are managing to significantly overcome demographically dictated disadvantages. There are three lines on the plot. The center line is the best fit line for all of the schools' actual performance versus predicted performance. The upper and lower lines represent those lines that divide the top and bottom 5% of schools from the others. The difference between a school's score and the middle line, or predicted score is called a "residual" or merit score. Those schools above the top line are schools that should be studied to see what they are doing to overcome demographic disadvantages. For a given demographic range, there is always a high performing school that can be studied to see what it is they are doing specifically that could be done by the lower performing schools, and particularly the schools below the bottom line. No more guessing and no more silver bullets! Let us go find out, instead of trying to spend money exercising someone's pet theory.

Additionally, these lines can be used to determine a school's grade. For example, any school above the top line should be given an A grade. Schools below the bottom line should be given an F. Schools clustering close to the middle line should receive a C.

If you ask if this is really fair, because schools should be graded on their absolute scores, then you need to know that absolute scores are always available. You also need to be aware that there are schools with disadvantaged demographics that score quite a bit higher than do schools with better demographics. If some disadvantaged schools can perform at a high level, then every such school should be able to do the same, but only if they know what works and how to put it into practice. Additionally, any school whose merit score is very high is doing far more than could be expected given their circumstances. If the highest absolute scoring school were to suddenly shift all of its students to the lowest, and visa versa,

it is probable that the lowest would increase performance toward what the higher school does and the highest school would similarly decrease its performance output to what the lower school was like.

Making wholesale transfers of students to try and get into better schools will simply change which schools perform the best – not fix any underlying causes for the lower performance. This method looks at, and provides data to educators that really work. It does not just "throw money" at the problem. It is a relatively inexpensive way of solving the problem. It finds those methods and techniques that actually work, as opposed to following the latest fad or someone's gut feel. If used, it has the potential to create a hero of the person who makes it happen!

(Kim Johnson is a former President and founding member of CESE)

Of Pandas and Polar Bears Dr. Paul Braterman

Keywords: sex, violence, baby swapping, mistaken identity, DNA testing, international relations, Viagra, Richard Nixon, Duke of Edinburgh, polar bear jail, global warming

Panda Bears

There are two species of panda. Let me correct that. There are two species, both of which are described as pandas, although one (the giant panda) is actually a member of the extended bear family, while the other (the red panda) is more closely related to raccoons. Despite appearances, these are not really sister species, more like second cousins. The red panda has similar diet to the giant panda, and a very similar “thumb”, but different size (much smaller), different colouring (brown and cream, instead of black and white, and with a ringed tail), and different range (further south and higher up). In both cases the famous “thumb” is, of course, nothing of the sort (both the giant panda and the red panda use all five digits in walking) but a modified wrist bone, and lacks a nail. All of this led the pseudo-textbook *Of Pandas and People*, at the center of the *Kitzmilller et al. v. Dover Area School Board* case, to give the panda a starring role, not only in the title but on its visually appealing front cover, and to devote 5 out of its mere 148 pages of main text to the alleged problem that pandas posed for classification. This, although the controversy had been disposed of back in 1964, is a classical study of detailed morphology that the book itself cites. It will come as no surprise that molecular phylogeny now confirms the essentials of the 1964 study, with only one minor modification, placing the giant panda as before in its own genus within the bear family but the red panda in a sub-family of its own, not actually part of the raccoon family proper, but still a close relative. *Of Pandas and People*, you may recall, had its own evolutionary history, having originally been written as “creation science” or “creationism”, transformed by horizontal meme transfer to “Intelligent Design”, and with the intermediate fossil form “Intelligent Designism” among the documents produced in court.

There is a serious philosophical or psychological point here, not just another example of creationists being silly (although that too, of course). Absolutist thinkers really do consider it a weakness that the scientific account changes over time, and fail to understand how this openness to self-criticism is essential to science’s robustness. This could explain why creationism is so appealing to lawyers, who rely on cases being finally settled, and conservative theologians of all faiths, who

regard their dogmas as established and attempts at revision as sinful.

It was the giant panda that graced the front cover of *Pandas*, that appears in the logo of the World Wildlife Fund (patron HRH the Duke of Edinburgh), and that pulls in visitors to zoos. Panda diplomacy also played a role in the restoration of normal relations between China and the West, one of the major achievements of the Nixon administration. The cuddly looking creature, with the big black patches round its eyes, has great emotional (and, as a result, commercial) appeal. Unfortunately, its very survival in the wild is threatened, and attempts to maintain numbers in captivity have run into great difficulties.

Pandas (specifically giant pandas) live almost entirely on bamboo. Unfortunately, bamboo is of very low nutritional value to the pandas, who have the digestive systems of carnivores rather than ruminants, so they need to eat up to 40 kg a day, and in the wild just doing this can take them up to 14 hours. They need very powerful jaw muscles because of the chewing involved, and these and their attachments are what gives the pandas their appealing round faces. Their habitat is under pressure, and numbers in the wild are down to about 1500. Thus the number in captivity (now over 300) is a considerable fraction of the total population. Pandas face very serious restrictions. They can only survive in areas where more than one species of bamboo is flourishing, since if they relied on a single species they would starve when that species flowers and dies back. They are such inefficient digesters that they have little energy to spare, and find it a problem to make their way up steep slopes. This may not have mattered too much in their original habitat in the Chinese lowlands, but now that people have taken up all the land suitable for agriculture, pandas bliley find themselves living in the mountains.

It has turned out to be enormously difficult to breed pandas in captivity, a feat not accomplished at all until 1963. Where’s the problem? Why not just put a male and a female panda together and let them get on with it?

Firstly, the female panda only comes into heat once a year, for about three days, during which she is only fertile for 12 to 24 hours. However, this fertile period can be detected by testing her urine. Then, most attempted romantic encounters proved very disappointing. The male (I’m not making this up; I have it from the BBC, no less) has a very short penis, so that accurate positioning is necessary, and they are not very good at doing this. Moreover, preliminaries in the wild involve

fighting among males for the privilege of mating, and this seems to be an important part of the arousal process. So despite measures ranging from sex education videos, to stimulating the males with sticks of bamboo carrying the female scent, to the use of Viagra, managed encounters in the zoo often end in disappointment or even violence.

The present successful breeding program in China uses artificial insemination (don't ask!). However, that doesn't put an end to the problems. Pandas very often display pseudo-pregnancies, quite difficult to distinguish from the real thing, even by hormonal testing. Ultrasound can be helpful here, but requires considerable skill because of the smallness of the fetus, as well as the cooperation of the animal. (The mother weighs around 100 kg or more; the new-born offspring, a mere 100g.) However, a new test involving detection of the electron transport protein ceruloplasmin in maternal urine has recently become available. Like other members of the bear family, pandas show delayed implantation of the fetus, and as a result, actual pregnancies can range between 11 weeks and 11 months. Because of the small size of the fetus, and the complications of pseudo-pregnancy, true pregnancies do not become obvious until shortly before birth.

Pandas usually give birth to two cubs at a time, but only care for one. This is thought to be because pandas lack the ability to build up reserves of fat, leaving the mother unable to make enough milk for two. So the expert panda breeders at the world's leading center in Chengdu have resorted to trickery, caring for the abandoned cub in an incubator, swapping the two cubs around when their mother wasn't paying attention, and supplementing the mother's milk with imitation bear milk. Both cubs do, however, need their share of mother's attention. They have weak immune systems, so they rely on antibodies in their mother's milk. They also need help in evacuating, which the mother supplies by stroking their lower abdomens with her tongue. However, this particular problem clearly resolves itself by adulthood, since a full-grown panda defecates 40 times a day.

The panda breeding programme is big business, with the Chinese retaining ownership of the beasts, and renting them out to Western zoos for \$1 million a year. This is over and above the cost of looking after them. Even so, the programme has been so successful that center-bred pandas are now being reintroduced into the wild. Suitable habitat has been bought, and will no doubt in due course be a major attraction for eco-tourists. Keepers involved in the reintroduction have been dressing up as pandas, so that their charges will feel more at

home when released. However, critics of reintroduction point out that the entire exercise is meaningless unless these pandas are being provided with enough protected habitat.

Polar Bears

Polar bears have many things in common with pandas. They are favorites at the zoo, carry strange secrets in their genes, and are adapted to a very specific shrinking habitat, with all that that implies.

Polar bears really are bears, not just members of the same extended family, having diverged from brown bears by a process of peripatric speciation (new species forming by adapting to conditions on the fringe of the species' range). But an unexpected fact is concealed in their mitochondrial DNA. They are all descended on their mothers' side from extinct giant Irish brown bears, although this is best attributed to cross breeding between established species, rather than to late emergence of polar bears as a separate population. During the million years that they have existed as a (more or less) separate species, polar bears have adapted their range to climate, and roamed as far south as the Thames Valley during the ice ages. What is going to happen now, as their preferred habitat on the land-sea ice boundary simply ceases to exist, is quite another matter. The London-based Daily Telegraph, which vacillates between simple global warming denial, and claims that warming is good for you, tells us that they are thriving, although the purely local increase in number that they report is known to be the result of restrictions on hunting. Early breakup of the ice makes it more difficult for polar bears to find food, leading to an increase in their attempts to steal food from humans. The inhabitants of Churchill, on Canada's Hudson Bay, have built a polar bear jail, where nuisance bears, under sedation from rifle-fired darts, are held before being transported to the wild. Global warming has led to the bears coming ashore a week earlier per decade, increasing the length of time during which the mother must feed herself and the cubs she is carrying from her accumulated fat reserves. This is already affecting numbers, and further lengthening of the starvation period is expected to lead to smaller litters, and decrease survival chances for each cub.

Under business as usual, polar bears are in real trouble. So are we.

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