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What Will It Cost to Save Piping Plovers?

Introduction:

Piping plovers are migratory shore birds that breed in North America in the summer and go to the Caribbean in the winter. Plovers breed in three distinct groups: one along the Atlantic Coast, one in the Great Lakes region, and one in the Great Plains. All three were listed under the Endangered Species Act in 1985. Since 1991 the Atlantic and Great Lakes groups have stabilized, but the Great Plains population has continued to decline. Recovery efforts have been poorly coordinated, with government agencies and volunteers doing their best with limited funds and no real plans. Michael Larson, a scientist who studies piping plovers, systematically evaluated methods of nest protection, thus giving us an idea of the most effective way of protecting birds on the breeding grounds, and how much it may cost.

ER: Dr. Larson, what is your training?

ML: I received a Master's Degree in wildlife ecology in 1995 at Michigan State University studying ruffed grouse populations. From there I moved down to Columbia, Missouri, to pursue my Ph.D. in fisheries and wildlife with Mark Ryan. His group has been studying piping plovers for the last nineteen years. I came to the University of Missouri to model piping plover population dynamics and also the economic aspects of the recovery process. I'm now a postdoctoral fellow in the same department.

ER: Can you tell us a little bit about piping plovers and where they live?

ML: Piping plovers are small migratory shorebirds, and they breed in three distinct populations in North America. There is a population that breeds along the Atlantic coast from North Carolina into Canada; there is a much smaller population that breeds in the Great Lakes; then there's a third population breeding in the Great Plains of North America from about Nebraska up through the southern half of the prairie provinces of Canada, mainly Saskatchewan and Manitoba.

ER: When do they fly north?

ML: Plovers arrive on the breeding grounds from mid-April through the beginning of May, depending on the site; and at any given site they show up at about the same time every year. Plovers start their nests in May. The plovers are monogamous within breeding seasons; the male and female pair bond is established once the birds arrive on the breeding grounds. Then the pairs form and defend a nesting territory. They nest semi-colonially, so plover territories bunch up and there might be parts of the breeding site that aren't used at all.

They lay a clutch of four eggs generally. The male and female alternate incubation responsibilities, usually about once every half an hour or hour. And the incubation period is about twenty-eight days, so most hatching is around late May or into the first two weeks of June. If a pair has a clutch they're incubating and a predator destroys it and there's enough time left in the breeding season, they will re-nest. But once they get a clutch to hatch, they won't re-nest after that.

ER: So they can make some more eggs if they lose the first batch.

ML: Yes. Re-nesting, or that second nesting attempt after a destruction or predation event, is fairly routine actually. I think they've observed up to four or five nesting attempts within the same breeding season. And oftentimes within that breeding season the pair

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stays together, so they don't have to go through the whole mate-forming sequence.

ER: Do the chicks hatch all at once?

ML: Yes, incubation doesn't start in earnest until the fourth or final egg is laid, so that synchronizes the hatching, and the chicks are precocial, which means when they hatch, they are pretty much ready to get up and walk, and the entire brood is able to leave the nest.

ER: Where do they nest?

ML: They nest on open beaches. On the Atlantic coast they use the ocean beaches and barrier islands. On the Great Lakes they use the big gravel and coarse sand beaches of the Great Lakes. In the Great Plains, the population that I have studied most extensively, about one third of the population breeds on sand bars in major rivers and along the shores of reservoirs. The remainder of the Great Plains population breeds on inland lakes, most of which are hypersaline, or alkali wetlands, which discourages vegetation growth, so the beaches are open. Plovers tolerate sparse vegetation, but they like fairly open beaches with a pebbly or gravely substrate. They won't nest on straight sand.

The pair scrapes away a shallow depression on open flat beaches, and often you don't even recognize the nest if you're not looking for it. Sometimes they line their nest with little shell or pebble fragments but it's not much of a nest to be built, they're laying the eggs right on the beach.

ER: Do they have mating rituals?

ML: Yes. They have fairly elaborate breeding displays. The males try to attract females with a certain flight behavior. Then, immediately before copulation there are some tilting and head-bobbing displays and foot-tapping displays. They also have territorial defense displays they do when they're establishing territories.

ER: Nesting out in the open like that may explain why they have to lay four eggs. It seems like they're geared to take some fairly heavy losses.

ML: That's still a fairly high research priority; that is, studying reproductive success and the sources and rates of predation on eggs and chicks. The nests are out in the open, but they are cryptic. The eggs are fairly dull, flat, gray, or tan, with some speckling, so if the nest is left exposed the eggs either blend in with the background or look like small rocks. The adult birds have a dull gray, pale coloring on their back, and when they're sitting there they too tend to blend in with the color of the sand and gravel.

Fortunately piping plovers nest at fairly low densities such that no predator tends to focus on plover eggs. There aren't enough of them out there to keep a predator happy or healthy, so plovers tend to get hit mostly by generalist predators.

A lot of the adjacent uplands in the Great Plains have high breeding duck densities, and there are other shorebirds that also breed on and near the beaches, things like avocets and in the river system common terns, least terns, and things like that.

ER: Do the three populations stay separate all the time?

ML: It's easier to talk about the three breeding populations, but then they all migrate south, and I think the populations are much less distinct during the fall-to-spring period. The females leave the breeding ground soon after the eggs hatch, usually within a few weeks and typically before the chicks fledge. The chicks become independent and fly on their own three to four weeks after hatching, and during that time they're brooded sometimes by both parents but more often by just the male.

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The males leave from late June into July and then the juveniles, or the young of the year, often don't leave until the end of August or early September.

ER: Where do they go for the winter?

ML: There are wintering concentrations on South Padre Island, but they are found along the entire Gulf Coast of the US and Mexico as well as the Atlantic coast of Florida down into the West Indies and other Caribbean Islands.

Extensive international censuses for piping plovers began in 1991. They try to survey the entire population on the wintering grounds in January and then again on the breeding grounds in June of the same year. That census has been carried out every five years since then, 1991, 1996, and then last year, 2001.

Unfortunately, only about half of the breeding population has been located on the wintering grounds. The wintering locations I mentioned contain about half of the breeding population. We don't know where the other half goes, presumably into remote areas of the Caribbean or coastal areas of Mexico or other parts of Central America that haven't been surveyed or aren't as accessible to people.

ER: How are they doing on the wintering grounds?

ML: A lot of the research focus is on the breeding grounds because that's up in the temperate areas, but they spend eight to nine months on the wintering grounds. Survival and availability of high quality habitat on the wintering grounds is a big component of plover conservation, but it seems to be of less management interest. Recent research along the southern Laguna Madre of Texas, however, indicates overwinter survival is quite high.

Piping plovers breed in three separate areas: the Atlantic coast, the Great Lakes and the Upper Midwest. They winter in the Caribbean.

ER: How long do plovers live?

ML: They can live five to ten years. As with many animals, first year mortality is much higher than it is once they reach adulthood. We've estimated annual survival rates are at least 74 percent both for the Great Plains population and the Atlantic Coast population; that means, three-quarters of the adults survive from year to year.

ER: Do they come back to the same nesting area every year?

ML: Adults are somewhat faithful to breeding sites. Some pairs come back and nest and take over the same territory from one year to the next; but sometimes they don't. For first-year birds, the probability of returning to the site where they were hatched is much, much lower than the breeding site fidelity of adults.

ER: Is the prairie upper Midwest a marginal habitat that they're exploring? It seems like their best breeding habitat would be along the saltwater shores and maybe big rivers. Are they trying to explore and find new places to nest?

ML: I wouldn't characterize it quite like that. In recent history plovers have experienced some distribution contraction because the population has declined. Sue Hague did her dissertation research on plovers in the 1980s and has been studying them ever since as well. She has done some genetic work that indicates the Atlantic coast was where piping plovers originated and that the Great Lakes and Great Plains birds are genetically distinct. Piping plovers are separated into two subspecies based on slight color and morphological differences. At a meeting a couple months ago Dr. Haig reported that the Atlantic coast and Great Plains populations diverged about 200,000 years ago. I wouldn't characterize the Great Plains or even

the Great Lakes as marginal habitat because they are suitable and some areas provide ideal habitat. There are mid-continent areas where plovers do quite well, and they've obviously survived here for quite some time already.

It's the aspects of the habitat that they key in on. They rely on open, sparsely vegetated pebbly to gravelly beaches and that occurs on the river sand bars, on the alkali wetlands, the Great Lakes and other freshwater lakes, as well as the Atlantic coast. The difference between fresh water and salt water doesn't tend to make a big difference to them.

ER: What do they eat?

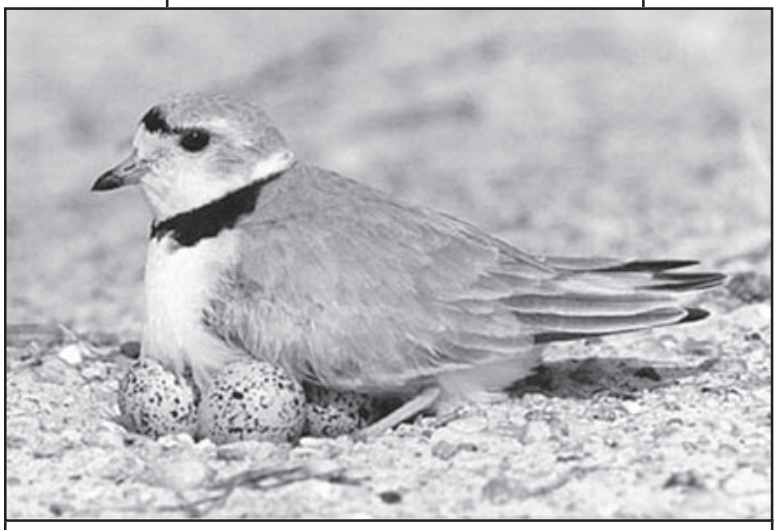
ML: The invertebrates that they're eating are usually gleaned from the soil surface but sometimes are down in the substrate. Plovers forage in a run-and-peck pattern. They don't have a real long beak to probe down, but they will get subsurface larval-stage invertebrates and worms.

The water in alkaline wetland basins is so saline that usually the only thing growing in them is brine shrimp. Often they rely on terrestrial invertebrates that get blown into the water and the wave action concentrates them at the water line, so they feed along the water line. They eat things like flies or even small grasshoppers.

ER: They are on the endangered species list. How many of them are there?

ML: In this last census there were about 2,900 birds in each of the Atlantic coast and Great Plains populations, so they're of approximately equal size. Then the Great Lakes population had seventy-one birds as of last summer.

ER: What would be a healthy population size?



In 1991 there were 40 plovers in the Great Lakes population. In 2001 the breeding population had increased to 71.

ML: That's a good question, and the answer is that we don't know.

ER: What was their historic population?

ML: That's what most of us would like to see as a recovery goal or some measure of security for the population, but it's unknown. No population estimates or extensive surveys were done until the mid-1980s. The general impression is that they were never abundant.

They were listed under the Endangered Species Act in 1985 in the US, with the Atlantic and Great Plains being listed as threatened and the Great Lakes listed as endangered. The three populations are listed separately, but at that point they were all experiencing population decline.

Since the international censuses in 1991, the Atlantic coast and Great Lakes populations have been increasing slightly, but the continued decline of the Great Plains has offset that such that the entire North American population of piping plovers has declined slightly to about 5,900 as of last year.

ER: How close were we to losing the Great Lakes population?

ML: In 1991 there were forty birds in the Great Lakes population. This is complete speculation, but I want to say that the lowest number was about thirteen pairs sometime in the mid-1980s. Since then they have been increasing there from that forty in 1991 to seventy-one last year.

ER: How accurate are those counts?

ML: The census has actually created some contention about population status. It is an actual census where they attempt to count all the birds. They search a lot of places, and over half the sites that they visit and try to count the birds they're not present, so we know they're looking.

I think the number of people out counting and the number of hours spent counting has increased over the three censuses, so I don't think counts from different years are as directly comparable as statistical estimates of population size based on a random sample would be. It's touted as a

census, but we know that they aren't counting all of the population so the percentage of the population that they're counting has certainly varied. I think it's been increasing, so again these trends over time from the censuses aren't exact. The interpretation of them is slightly complicated, but for any given year they are our best estimate of how many birds are out there.

ER: Is that rebound in the Great Lakes population due to any human activity or is it a natural fluctuation?

ML: I think it's due to a lot of good work by many people. The three different populations face different threats. On the Atlantic coast it was mostly shorefront development that destroyed habitat, as well as such a high density of human population. Both disturbance during the breeding season by humans on beaches, and domestic and feral cats, which are efficient nest and chick predators contribute to the losses. In the Great Lakes the threats are similar, with some lakeshore development, human disturbance, and predation of eggs and chicks by a variety of predators.

In the Great Plains human population densities are lower and a large part of the plover population breeds at these alkali sites that aren't prone to development or drainage because the soils are so alkaline that they wouldn't be appropriate for farming, so the habitat has remained mostly undisturbed.

One of the general threats is vegetation encroachment on the beaches. That's due to several factors. The prairie fires used to come through on a much more regular basis to burn what vegetation might have been on the beaches. And it is believed that bison grazed heavily on alkali beaches and over time the churning of their hooves scraped away vegetation from the beaches.

When there is loss of habitat on the river systems it's a lot easier to point the finger at human alteration of water levels. The suppression of spring floods prevents the formation of new sand bars and it prevents the scouring of vegetation from existing sand bars. So again if there're no floods to come through and wash it down you see the vegetation encroachment and willow and riparian plants that grow up and take over some plover habitat.

But the main threat in the Great Plains is predation of the eggs and chicks. That's speculative because we don't have any historical data on predation, but given that the adult survival rates are similar between the Great Plains and the Atlantic coast populations, and with similar shorebird species, we think reproductive success has been depressed. Small predators on the Great Plains occur in higher densities for several reasons. The wolf and grizzly bear, which have been extirpated, used to eat the smaller predators, and municipal and farm wastes and abandoned farm sites support higher than historic predator populations as well.

ER: What are those predators?

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Fencing plover nests to protect the eggs from predators has proved to be effective.

ML: Raccoons, skunks, foxes. One of the main bird predators is the crow, and gulls have been observed taking chicks. If gulls are serious predators of plover eggs and chicks, that would be a big problem because gulls breed in dense colonies and oftentimes these colonies occur on the same wetlands that plovers are using. You can see gulls floating and hovering over plover nesting beaches all day long all summer, but we have not observed many direct takings of eggs and chicks by gulls. We think it's the generalist egg predators but we're not entirely sure.

Getting back to the original question of human activities for conservation or what's helped the Great Lakes population expand, there are lots of efforts to restrict use of certain beaches where they'll either fence or prevent people from walking their dogs or people driving their ATVs on certain beaches. Sometimes they'll put up signs that say, This is a nesting site of an endangered species, use extreme caution. Those kinds of things help with direct human disturbance.

But also, as with the Atlantic coast and Great Plains populations, managers use small cages to place over individual nests to exclude predators. It involves welded wire or poultry fencing in a circle maybe up to three meters diameter and a meter tall and placing it right over individual nests. The lids are either soft wire mesh or netting. The adults can get in and out to exchange their incubation and the chicks can get out, but predators can't get in.

ER: That sounds like a labor-intensive practice.

ML: Very much so and that's one of the things I studied for my dissertation. People saw that nest predation was a big problem so they devised these nest cages. Sometimes you can put up a fence around an entire nesting beach to prevent mammal predators from walking out there. But as you said, that's labor intensive and expensive because you have to purchase fencing materials and build cages.

People were applying these methods opportunistically or somewhat haphazardly without any real indication of either the impact or the overall cost. So I took a population-wide view of predator exclusion management for the Great Plains population to determine how much we are spending per breeding pair per year to exclude predators. We wanted to determine the most efficient way to do that with fences and cages, and determine what proportion of the population we need to protect from predators to reverse the population decline.

Piping plover eggs are well camouflaged.

ER: What did you come up with?

ML: I evaluated five different management techniques: individual nest cages, two different type of fence, a permanent fence that's there year-round for ten or twenty years or a portable temporary fence that you can get into more remote sites; and then cages and fencing in combination. Private landowners are much more likely to use temporary fencing because it is only in place for a couple months each year. I also had a sixth category of no predator exclusion management to serve as a baseline.

ER: What tactic worked best?

ML: It was interesting that the annual cost of applying the different techniques didn't vary widely. You would think that something as cheap as a little wire cage to put over a nest would be a lot less expensive than putting up a big permanent fence that's electrified and involves buying an energizer and battery. But the largest component of the cost was technician labor. Once you've decided to protect plovers on a certain beach, the technicians are going to have to be there. So what it came down to was, it's most efficient to go all out, to use fencing and cages combined.

ER: How many chicks does one pair of birds contribute to the population in a year?

ML: Baseline levels without exclusion in the Great Plains were about 0.9 fledglings per pair.

ER: That would be a declining population.

ML: Yes. And again, I made the distinction between birds that were breeding on the lakes versus birds that were breeding on the rivers and reservoirs, because it's a somewhat different threat and the Army Corps of Engineers does a lot of different kinds of management on the river. Reproductive success on rivers depends on water level fluctuations.

The Corps has a captive rearing facility where they do go out and collect eggs that are in danger of being washed out by rising water levels. They'll take some of the eggs in and hatch them and raise them and release them back on the beaches. They've had apparently decent success with that, although it's not big numbers. They released about fifty fledglings last year.

ER: What was the effect of exclusion devices on the success rate?

ML: With nest cages it increased to 1.3 fledglings per pair, with nest cages and the temporary fencing it was 1.8, and with cages and the permanent fencing it was 2.2. So each treatment was a fairly substantial increase.

The Atlantic coast population has a similar adult survival rate, and therefore we believe a similar first-year survival rate. They're seeing population increases with a mean fledging rate of around 1.4.

ER: What did you use the computer models for?

ML: I used a population simulation model, which was slightly more pessimistic on the baseline than the censuses. It was indicating about a 4 percent decline per year in the population using the baseline reproductive success and survival rates. The censuses were indicating about a 2 to 3 percent annual decline.

Then I ran a scenario of proposed management and there was a definite improvement in the population. The take-home message of all that was that the intensity of predator exclusion necessary to stabilize the Great Plains population is economically and biologically feasible.

The simulation model showed that the population stabilized, or the decline ceased, with a reproductive success level of about 1.2 fledglings per pair. With the Atlantic coast at 1.4 and my modeling indicating around 1.2, and current levels in the Great Plains being as low as 0.9, it does take a substantial effort to get it up to that stabilization level. My economic models indicated that that's going to cost in the tens of million of dollars over a fifty-year timeframe.

The main threat in the Great Plains is predation of eggs and chicks.

So the outcomes of my modeling and the potential for the actual population are still all over the board. We could continue to see population decline, or if we increased predator exclusion management we might be able to stabilize or even increase the population, but it depends on what gets done out there.

ER: What is that tens of millions of dollars being spent on?

ML: All my economic data related to the fieldwork associated with applying predator exclusion, so that was technician labor, materials, transportation or vehicle costs, but not things like supervisory or administrative labor, or overhead. This is the actual field application, the tangibles of predator exclusion.

ER: What got the Fish and Wildlife Service moving on this?

ML: Defenders of Wildlife sued the US Fish and Wildlife Service because the Service had not designated critical habitat for the Great Plains population, so the Service was under court order to do that. Last June they issued the proposed rule on critical habitat designation.

When it came out that the Service was going to designate critical habitat, many people were worried that it was going to restrict land use on private lands or restrict development; I don't think it will. It looks like they're designating most of the breeding range and they excluded areas where plovers did not occur at least two years out of ten, but everything that has had plovers breeding on it at least two years out of ten was designated.

ER: What does that designation entail?

ML: The critical habitat designation is an indication for federal agencies that if they have any projects on those lands they now require a Section 7 consultation with the Service, but I don't think it's resulting in much difference in terms of hindering development or infringing on private property rights because any federal action that would involve any taking of plovers or their habitat would require a Section 7 consultation anyway. If plovers are on the site it requires the consultation. So it didn't do much to private land issues I don't think, but lots of people were

worried about it, businesses and private landowners.

In much of the Great Plains development isn't that much of an issue. The biggest issue in the Great Plains in the last several years has been management of water levels on the main stem Missouri River. The Army Corps of Engineers is in the process of revising their master manual for management on the river, and I'm not exactly sure where that process is. Certainly plovers and least terns, another endangered species, have gotten a lot of press as it relates to that.

ER: The Atlantic population doesn't have that designation does it?

ML: I don't believe so. I think the Great Lakes breeding grounds and the wintering grounds in the US for all three populations received critical habitat designations a year or two ago. I'm not aware of any designation on the Atlantic coast.

ER: That would be politically more problematic because of the higher densities of people and higher real estate values on the beachfronts.

ML: I would think so.

ER: But that population seems to be stable or slowly growing. Is that correct?

ML: That's how I would characterize it. The census numbers have been increasing. I think it would be safe to say that they're at least stable, and most people would probably tell you that they believe it's increasing.

ER: Why is that?

ML: They have a much easier time getting volunteers out there, so they have programs for monitoring beaches. They get people that live close, or other people that might be birders anyway go out to monitor and volunteer to do the footwork and fieldwork that you need to pay technicians to do in the Great Plains, so I think they've had a lot more public involvement in the recovery. It seems to be working fairly well. They use the nest cages quite extensively.

ER: So first you looked at how to get a recovering population, then you looked at the cost?

In the last census there were about 2,900 birds in each of the Atlantic Coast and Great Plains populations. The Great Lakes population population had seventy-one birds last year.

ML: I had two different models that I developed and worked with. We talked about the population simulation model. The other was an optimization model in which I combined the reproductive success rates and the financial costs of predator exclusion. The model had two objectives: to outline a predator exclusion strategy that would maximize fledging rates and to minimize the costs. We wanted to find the combination of management efforts that increased plover reproduction to stabilization levels at the least cost.

The other objective was to see what the highest reproductive rate of plovers might be. Under the constraints that I used, the model predicted that some simulated populations should increase over time if we could increase the reproductive success of the birds.

Each population has its own recovery plan. The original Great Plains recovery plan was based on the best information available at the time, but the target population size for recovery was fairly low. In our analysis I used a recovery level of 4,000 females, and that is substantially higher than the official recovery objective in the recovery plan. But to give you some ballpark on that, recovery criteria for the Great Plains population are from 5,400 to 8,000 individuals, and now we're sitting at about 2,900.

ER: That's a small population. It seems like on shaky ground, but if it's relatively stable from year to year and dispersed then it shouldn't be too much cause for worry.

ML: Right. Even with a recovery level that seems somewhat low, if we get there that means that the plovers have experienced some increase, but it is going to take some fairly intensive management to do that. If predators are reducing reproductive success rates, the best way to go about it would be to manage plovers and their predators on a landscape level, whether it's with land use practices or larger policy issues that would in the long term help make the population more sustainable. But if we use a labor intensive, financially expensive predator exclusion process, the population might begin to decline again if we were to reduce or stop the exclusion. The alternative is to continue this in perpetuity, and most people don't like to think about that because of the costs.

ER: What is the point of the computer modeling?

ML: The main questions were: Is what we're doing having an impact on the population? If so, how much do we

have to do to stabilize or increase the population? And what's it going to cost?

In the range of from 10 to 15 million dollars over 40—50 years for fieldwork due to predator exclusion was one of the main outcomes, which is more than what's being spent currently. People holding the purse strings now have the information they need to decide. If we're committed to plover recovery, we need to commit to this type of financial support. Alternatively, if the purse strings don't open up and the population continues to decline, recovery will get even more expensive and the onus will be on the people that had the ability to make a difference and didn't. The information is there now to make a sound decision.

Personally I feel like it should force somebody's hand at some place along the line, because up to this point the application of predator exclusion had been opportunistic and haphazard. Several managers with leftover operating budget monies might be able to buy some fencing material and put up thirty cages a year. But they were having to take money out of other budgets, whereas now maybe this can become a line item on somebody's budget because they know they need to finance recovery at this level.

Aside from costs, we were also interested in the biological or population output. The conclusion was basically, Yes, it is still feasible to recover this population.

A population simulation model was published in Biological Conservation a couple years ago that indicated that the Great Plains population was going down the tubes quickly. The take-home point could have been that it's not worth trying to save this population. That scared a lot of people who care about plovers and have been working a long time to recover them, especially in the Great Plains. It painted a pessimistic picture for the future of Great Plains plovers and there was serious doubt at that point about whether or not recovery was even feasible.

My modeling of increased predator exclusion showed that we could increase reproductive success enough to stabilize and potentially even cause population increase, so it is still feasible.

ER: Fifteen million dollars spread over fifty years and several states doesn't seem quite so daunting.

All three populations were listed under the Endangered Species Act in 1985. Since 1991 the Atlantic and Great Lakes groups have increased slightly but the Great Plains population has continued to decline.

ML: If the population were to increase, protecting the same proportion of the population is going to get more expensive. But I think the numbers we're working with, on the range of $100,000 to $500,000 a year for predator exclusion, are within the means of federal-level recovery.

The expenditure for endangered species is so diverse, and generally the top six species tend to get the multi-millions (the grizzly bears and the spotted owls and things like that), but piping plovers are up in the top ten. The amount of money spent goes up exponentially for the top few species. I think the money's there somewhere to do this, so that's why I claim that recovery is economically feasible as well.

I've shown that it's biologically and economically feasible. However, to implement the plan that I outlined in my dissertation requires cooperation and coordination on a large scale.

I worked on the entire population, whereas the managers are working independently. Somebody's able to protect a few here and somebody a few there, but there is no comprehensive, coordinated management plan. Some managers in the Great Plains are trying to get together and protect a core portion of the population.

The recovery plan for the Great Plains population does not outline specific activities or how to go about recovery, so there's a definite need for a population-wide management plan.

That was the overall conclusion of my work: beyond feasibility, people need to know that recovering plovers is going to take cooperation and coordination. Somebody should be working on this management plan and making sure it stays efficient.

Optimization modeling is not all that complex of a process, but one of the benefits is that you end up with these least-cost, or financially efficient alternatives. I think that is the language that legislators and administrators want to hear. It's not only, Okay, you want tens of millions of dollars over the next fifty years. How is it going to be spent? How do I know it's going to be spent well? This model tells us this is the most efficient way to do it and we couldn't do it with any less money.

Will Bluefin Tuna Be Allowed to Recover?

Introduction:

The Atlantic bluefin tuna are a prized sport fish, a fast-swimming predator of other fish, and a source of high priced sushi in Japan. A mature bluefin can reach seven to eight feet in length and a weight of several hundred pounds. Such a fish is worth many thousands of dollars in the sushi trade. For the last ten years the bluefin population in the West Atlantic has been about 10 percent of its historic or natural level due to overfishing. The international commission that sets catch quotas on the fishery has set a quota of about 2,000 tons of bluefin per year in the West Atlantic during this time. The quota has slowed the decline of the population but has not allowed it to rebuild.

We spoke with Dr. Elizabeth Babcock of the Wildlife Conservation Society about her work to help recover the populations of this extraordinary top predator of the seas.

ER: Dr. Babcock, what is your training?

BB: I got my Ph.D. in fisheries biology from the University of Washington School of Fisheries in Seattle in 1998. After that I got a job at the Wildlife Conservation Society in New York. WCS was founded a hundred years ago as the New York Zoological Society and it does fieldwork all over the world, working with a wide variety of species; for the last five years we've been interested in fisheries issues. My job is primarily to work with fisheries stock assessment; that is, the scientific information that is used to advise management of fisheries. I work on bluefin tuna, swordfish and sharks, and I'm starting to work on white marlin.

ER: Why are you interested in those fish?

BB: One reason, of course, is that they are so big and charismatic, but all of these species that we work on are seriously depleted. These are all species that are highly migratory and are fished both within the territorial waters of various countries and also in international waters, which means that it's problematic to manage them. Historically most of them have been overfished. All of those species I mentioned — bluefin tuna, white marlin, swordfish, and quite a few shark species in the Atlantic — are all overfished.

ER: What is the market for bluefin?

BB: The current fishery is mainly focused on the sushi market. Bluefin tuna are one of the more valuable species in Japan because bluefin tuna, also called toro or fatty tuna, is one of the most expensive and popular dishes in sushi restaurants. That market in Japan is what drives the modern fishery. It's mainly a long-line fishery, though there is some purse seining.

ER: Where do you work?

BB: I work with the Western Atlantic population of bluefin tuna. We assume that there are two populations on the North Atlantic, one in the Western Atlantic and one in the Eastern Atlantic; the Western Atlantic population is about one-tenth the size of the Eastern Atlantic population. Over the last two years new tagging data indicates that there's more migration between these two populations than had been assumed in the past. Historically they've been managed as if they were two completely separate populations and two completely separate fisheries, but it looks like the migration rates are fairly high. It's even possible that fish move between the western spawning area in the Gulf of Mexico and the eastern spawning area in the Mediterranean Sea.

ER: The Mediterranean is highly polluted.

BB: It is. Bluefin tuna spawn in the Mediterranean, and the fishery there has been pretty much out of control for the last ten years. There's theoretically a total catch quota imposed on the eastern fishery, but it's exceeded every year. Some countries don't even report their catches, so we don't have a good idea of what the total catch is in the Mediterranean and in the Eastern Atlantic. That population is certainly declining, and there is a real need for more management and enforcement in the eastern fishery.

ER: Who is responsible for managing bluefin?

BB: I should focus on the western stock, which is the one that I've worked on the most. Both the Eastern and Western Atlantic stocks are managed by the International Commission for the Conservation of Atlantic Tuna (ICCAT), which is an international management body that was formed by a treaty among the nations that fish for tuna in the Atlantic.

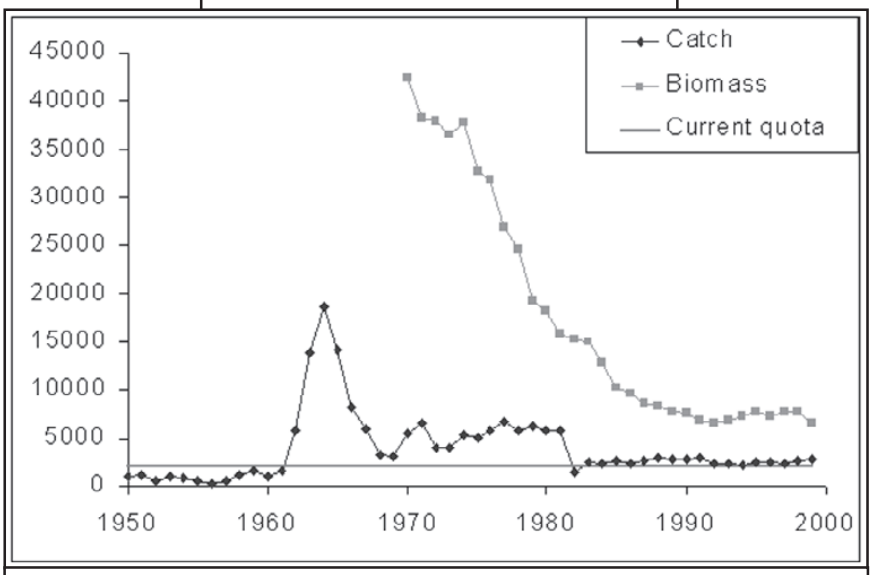
The ICCAT Commission, which is a political body, makes the decisions about what the total catch quotas can be for each species that they manage, including Eastern and Western Atlantic bluefin. That decision is made on the basis of the scientific report that's produced by the ICCAT Standing Committee on Research and Statistics, which has working groups on each species that do the stock assessment.

The part where I participate is at these working group meetings that do the stock assessments. The stock assessment meetings have been generally every two years, so there was one in 2000 and there will be one this year in July.

For the Western Atlantic the bluefin population is at about 20 percent of the level that it should be. The current goal of the management is to rebuild to a population level that will allow the greatest catch to be taken every year without depleting the population. Currently the stock is at about 20 percent of that level.

Both the US law and international law require rebuilding to at least that level. The current population is at 20 percent of that level, maybe about 10 percent of what it was historically before the fishery developed. It is quite depleted, even in terms of conservation biology and not fisheries, it's at a low level.

Bluefin isn't even the worst of the ICCAT species. The white marlin and blue marlin are both severely depleted and still declining. At least bluefin tuna has stabilized a little bit. It hasn't declined all that much since the early nineties.



The history of Western Atlantic bluefin tuna management.
(From the 2002 ICCAT stock assessment.)

ER: What does the commission do to protect the fishery?

BB: ICCAT has been setting quotas at around 2000 to 2500 metric tons for Western Atlantic bluefin since the mid-eighties. That level of catch is low enough to stop the population from declining any further, but it's not allowing the population to rebuild to a higher level.

This 2500 metric tons is allocated amongst all of the nations that fish for Western Atlantic bluefin tuna, which is mainly the US, Canada and Japan. Each of those countries has such a small quota that they can only take bluefin tuna as by-catch and they end up discarding quite a few bluefin tuna because they've exceeded their quota.

ER: So they're caught and then thrown back?

BB: Yes. That's exactly right. Fishermen are not allowed to keep bluefin if they've already caught more than their limit, so they throw them back even though they're already dead. In bluefin tuna science everything is subject to debate. There are a lot of uncertainties, and one of the uncertainties is how many fish are discarded dead every year. The reports in logbooks in the US fishery have been lower than the numbers estimated from observer data.

ER: The quota is an incentive to waste fish.

BB: That's right, and that's typical in fisheries. The more restrictive the management has to be, the more discarding there is, particularly when there are limits on how many fish can be landed in a particular trip.

I've seen video from long-line vessels where they have a trip limit of one or two bluefin and they want to catch the biggest fish that they can, so they keep everything they catch and then on their way in throw them all

away except for the biggest one. That happens because the quotas are set low because the stock is so depleted; if it could rebuild to a higher level there could be a lot fewer restrictions on the fishery.

ER: The juvenile tuna are probably not living long enough to reproduce.

BB: That's right. The average age in the catch is fairly low. The fish start to be susceptible to the fishery at age one. They grow quickly when they're young, so even the one year olds are caught in the purse seine fisheries. Certainly the mortality on the juvenile fish is quite high. That's one of the main problems.

ER: Is there any place where they're not fished?

BB: There used to be. The reason that the two stocks in the Western and Eastern Atlantic have been managed separately for so long is that historically there wasn't much of a fishery in the Central Atlantic.

Twenty years ago ICCAT arbitrarily drew a line at 45 degrees west and assumed that everything west of that was the western stock and everything east of that was the eastern stock. That worked for years because there was no fishing in the Central Atlantic, but then fisheries started expanding out into the Central Atlantic. The central Atlantic catches are mainly counted as eastern Atlantic fish because they're east of the line, but they're targeting fish that might not have been susceptible to a fishery before that central Atlantic fishery developed.

There pretty much isn't any place in the North Atlantic that doesn't have at least some long-lining effort. There are a few closures in the territorial waters of various countries; there's a closure in the Gulf of Mexico to protect juvenile bluefin tuna in US waters, but in the high seas there aren't any closures and I don't know if there ever will be for bluefin tuna. ICCAT is looking at the idea of having closures in the high seas for protecting juvenile swordfish, and that certainly could be done also for bluefin tuna. It's a good idea.

ER: How good is the catch data?

BB: One advantage with bluefin tuna compared to some of the other highly migratory species is that most of the catch of bluefin, at least the large bluefin, goes into the Japanese market, which means that you can use data from the Japanese market to determine what the total catch was. So we have at least some understanding of how high the illegal and unreported fishery catches are. That's not the case for some other species where there's a lot of fishing on the high seas and we have no idea where the catch goes.

It is possible to control the bluefin tuna fishery with a quota, at least in the West. In the Eastern Atlantic they've had less luck in keeping the catches down.

ER: Is that because of lax governmental control?

BB: That, and it involves more countries. In the West it's pretty much the US, Canada, and Japan; in the East it's all of Europe and North Africa, plus the high seas fleets. It's a much more complex fishery involving many nations that have less of a history of controlling the behavior of their fishing fleets.

ER: That puts American fisheries management in a good light for once.

BB: ICCAT is one context in fisheries management where the US and Canada are often the good guys.

ER: What is the plan for bluefin?

BB: ICCAT has a rebuilding plan for bluefin tuna, which means that they are setting total allowable catch quotas that should allow the population to rebuild. It's a twenty-year rebuilding plan that started in 1998, so theoretically the commission believes that the population will have rebuilt by the year 2018.

The population dynamics models that are used with these stock assessments often produce ambiguous results. At the 1998 assessment there were two different scenarios about the relationship between spawning stock biomass and recruitment of young fish. Those two different scenarios — and no one has any idea which of them was more realistic — ended up giving different results about what the prospects of rebuilding were.

Under one scenario the population would decline and under one it would increase. But then in the year 2000, in the next assessment with the same two scenarios, they were both optimistic. Both predicted that the current quota would allow the population to rebuild in twenty years. That's in a way, a fluke of the fitting methodology and the data.

We have no idea what's going to happen at the assessment this year. There's a lot of political pressure from the fishing industry to raise the quota because there's some indication that the population might be rebuilding a little bit.

ER: So they want to hammer the fishery again.

BB: Right. Every time the current year's biomass is a little bit higher than the last year's the fishermen want to take some of those fish. The idea of keeping the quota low so that the population can rebuild faster is not a popular one politically. Pretty much only the conservation organizations take that point of view, although US law does require rebuilding overfished populations.

ER: What law is that?

BB: The Magnuson-Stevens Fishery Conservation and Management Act says that populations that are overfished must be rebuilt in ten years if that's possible, and if it's not possible to rebuild in ten years they have to be rebuilt in the number of years it would take to rebuild if the fishery was closed, plus one mean generation time of the fish population.

The law is specific that populations need to be rebuilt rapidly. Of course, this is ICCAT and ICCAT doesn't have that ten-year rule.

ER: I understand they are a top predator.

BB: Yes they are, although they're hunted themselves. They're the prey of some of the fast pelagic sharks. Mako sharks hunt bluefin tuna.

Shark biologists enjoy telling people that mako sharks can out-swim a bluefin tuna. There's a quote about mako sharks in Hemingway's *The Old Man and the Sea* that I always liked. It said about mako sharks, They were built to out-swim the fastest swimmers in the sea.

ER: Do you have any evidence of them shifting prey species or changing their hunting patterns?

BB: There are quite a few biological studies being done of one sort or another, a lot of work on tagging and on the reproductive biology. For the most part, though, studies that have been done on bluefin tuna have been looking for the information needed for the science that informs management.

There hasn't been all that much diet and food web research because that's not the information that's used in stock assessment, or historically that information hasn't been used in stock assessment.

There is a trend in fisheries toward considering more ecosystem processes in management. To do that sort of thing you need to do more diet studies.

I would say in general the state of knowledge about biology for bluefin is better than many of the other highly migratory species. For this work I've been doing on white marlin, I was shocked to discover that no one's even aged them. One of the first things you need to know is how many fish of what ages are being caught in the fishery and what age they mature so you know whether you are fishing on the immature part of the stock. It's not known at all for white marlin, even though they've been fished for decades. At least we have good catch at age data for bluefin.

ER: Why do we know so little about their biology?

BB: With the highly migratory species for the most part if there is any biological data it's done by piggybacking on commercial and recreational fishing operations. There's little data that's independent of the fisheries, with the exception of some of the tagging information.

ER: What is the relation of bluefin tuna to a can of tuna in the supermarket?

BB: Bluefin tuna is found in cold water, as far north as Newfoundland in the Western Atlantic. The tunas that you get in canned tuna are mainly the tropical tunas. In the Atlantic it's bigeye, skipjack, albacore, and yellowfin tuna. These are all productive species that live in tropical waters, mainly in upwelling zones. They're prolific, they can support large fisheries, and they're mainly caught with purse seines. There's a big fishery in the eastern tropical Atlantic. There's another big fishery in the eastern tropical Pacific targeting tropical tunas, and that's where most of the canned tuna comes from.

ER: What about the prospects for this summer's ICCAT meetings.

BB: There are a couple issues that we are expecting to address at the meeting this summer. First of all, I mentioned earlier that the 2000 assessment was optimistic. The reason for that was that the population dynamics model that we were using estimated that there were good year classes in 1995 and 1996, some of the highest recruitments that had been seen in the entire time series. That would be good news if it were true, but the numbers of fish in the young age classes are not well estimated by the model because they haven't been in the fishery for long.

Probably the biggest issue we need to resolve this year is whether those two high recruitments happened or whether it was a fluke in the model fit. If we did get two high recruitments in 1995 and 96, then the signs are encouraging and it should rebuild faster than we expected. If we didn't get those high recruitments, if with two more years of data we estimate much lower numbers in those years, then the situation might be worse than it looked two years ago. That's one big issue.

The other big issue is that the working group has decided to try to address this question of migration. So all of the national scientists from the various participating countries have been asked to present their catch data split up by regions so that we can separate out the Central Atlantic.

Sport fishing for bluefin tuna can be a thrill.

ER: What effect would that have?

BB: We don't know what the effect of this new modeling approach will be. We've had the assumption that there was an Eastern and a Western Atlantic stock for as long as ICCAT has been managing these species, and it could be that if we move the boundary line or split out a Central Atlantic region that the outputs from the population dynamics models might be quite different, so that might require a higher or a lower quota in the east or the west. We don't know what the results of that are going to be.

I guess I should say one final word about the political implications of all of this. If the stock assessment this year shows that the population seems to be rebuilding there will definitely be political pressure to raise the quota, but all the environmental groups that work on bluefin of course will be opposing that and trying to rebuild the stock more quickly.

The current total allowable catch is 2500 metric tons, which is about what it's been for the last twenty years. It seems that if a quota around 2,000 or 2,500 metric tons could rebuild this population it would have done so.

ER: What is the structure of the management committees that make these decisions? Who votes on that?

BB: There are two parts of ICCAT. There's the scientific process, which is all these working group meetings. The Standing Committee on Research and Statistics meets in September and produces a document that summarizes the information on all the species, and that process is not particularly political. Some scientists who are funded by the industry or by conservation organizations go to these meetings and participate, but it's a scientific process.

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Environmental Review

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August 2002

Then the politics starts at the Commission meeting, which is in November every year. Each member nation sends representatives to the Commission that are political appointees. There are three representatives from the US, one of them is from the U.S. government, one is a commercial fisherman, and one is a sport fisherman.

Each nation has its agenda going into ICCAT. Mainly they want to keep their own quotas higher. There's a lot of horse-trading that goes on because each country has different species that they care about.

Then at the Commission meeting it's all one big negotiation to see what the end result will be. According to the ICCAT charter they have to reach a consensus, which means that basically any country that wants to dissent from a consensus can prevent a management action from being taken. It's a painful political process.

But I don't actually participate in the Commission meetings. The scientific process is much more promising from a conservation point of view. We have been working to get the ICCAT working groups to use methods like decision analysis to deal with all the uncertainty about bluefin tuna biology and fisheries. Over the years, the assessments are becoming more sophisticated, and our ability to predict the consequences of management actions is improving. And the management does depend on the science as well as the political process.

NEXT MONTH

WHY ARE STELLER SEA LION POPULATIONS DECLINING?
Douglas Demaster

ELEPHANT CONSERVATION IN WEST AFRICA
Lori Eggert

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