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## American Eel: A Symposium. Session Four

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Dr. Alan Walker

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**AMERICAN EEL: A SYMPOSIUM  
SESSION FOUR: EUROPEAN EEL EXPERIENCE**

***Moderator & Panelist:***

*Dr. William Bradnee Chambers<sup>1</sup>*

***Panelists:***

*Dr. David Freestone<sup>2</sup>*

*Dr. Matthew Gollock<sup>3</sup>*

*Dr. Alan Walker<sup>4</sup>*

**Bradnee Chambers:**

Hello, everybody. We are going to do the European eel experience now. I guess people are still preoccupied with the American eel experience.

My name is Bradnee Chambers, I am the Executive Secretary of the Convention on Migratory Species. This is a U.N. Convention, a global convention, and I will be talking about that a little more tomorrow. . . .

Today's panel: we are basically going to do some comparisons and have a look at the science and see some of the pressures and threats and some of the management regimes that are in place for the European eel. And hopefully from all of that we will be able to draw some good foundations for some conclusions tomorrow on the way forward.

We have a great panel today and we are going to kick off with David Freestone. . . . He is a very well-known international environmental lawyer; actually a legend for all of us who were studying at the time, especially on fisheries and other issues like climate change. He also [had] a long, illustrious career in the World Bank as the Chief Counsel for [Environment and International Law at] the World Bank, and [then as] Deputy General Counsel. He decided he is now going to now take up studying eels. He is the Executive Secretary of the Sargasso Sea Commission and he is going to kick off the panel.

**THE SIGNIFICANCE OF THE SARGASSO SEA AND THE SARGASSO SEA COMMISSION**

**David Freestone:**

Bradnee, thank you very much. . . . I have already spilled the beans and told you we have been responsible with great help from Matt Gollock in getting the European eel listed under the Convention of Migratory Species Appendix II.

But, I thought it would be quite useful . . . to tell you a little more about [the Sargasso Sea Commission] – who we are and what we do. You have all heard of the Sargasso Sea because you are eel specialists. But what I thought that I would do is actually say a bit more about it. . . .

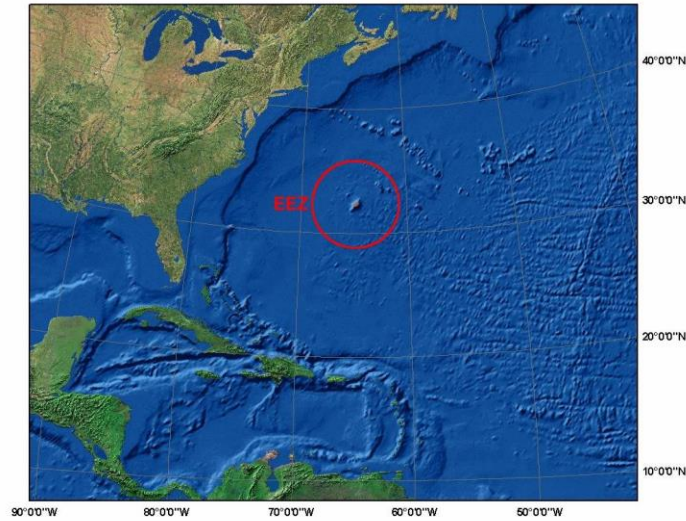
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<sup>2</sup> Executive Secretary, Sargasso Sea Commission.

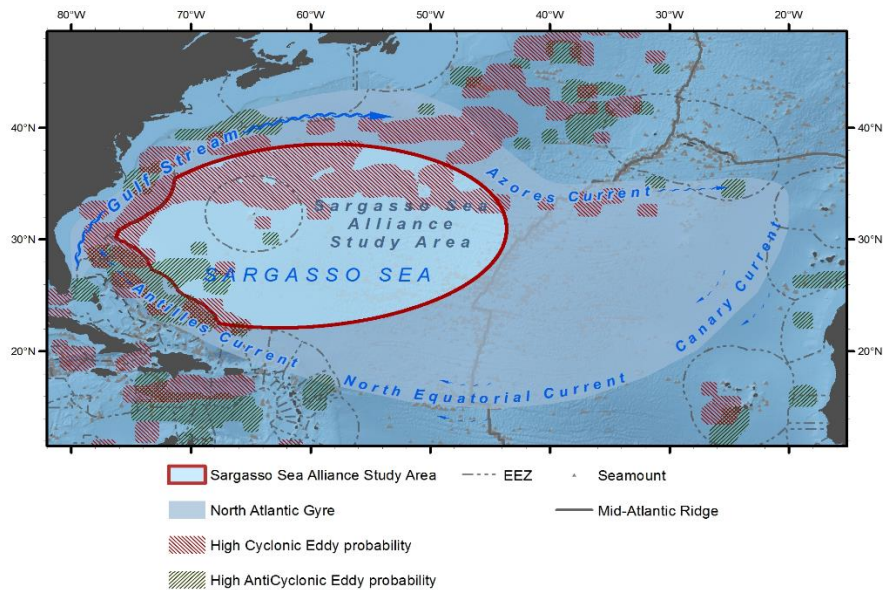
<sup>3</sup> Chair of the IUCN Anguillid Eel Specialist Group, Zoological Society of London.

<sup>4</sup> Representative from CEFAS; ICES WGEEL Chair.



*Figure 1. Map of Bermuda EEZ.*

[Although the Sargasso Sea Commission is led by Bermuda, most of the Sargasso Sea itself] is an area beyond national jurisdiction. [As] an international lawyer, [I am interested in how it is actually possible under current international law] to protect a high seas area. That is what we are trying to do. [We could have possibly tried to negotiate] a new treaty [to protect this high seas area], but that would [probably] take 20 years to negotiate . . . . It may be possible to do it using existing international organizations. So that is what we are trying to do.



*Figure 2. Map of Sargasso Sea.*

The first thing that we did was to identify [the exact location of] the Sargasso Sea. Some of the maps show that it goes well beyond the mid-Atlantic ridge out to the Azores, but . . . the core area is the subtropical gyre. These are the currents you may have heard about. But also historically, if you take a lot of maps of the Sargasso Sea and overlay them, [it is in the gyre] where the largest mass [of Sargassum] is found.

So why is it important? We know [that it is the only spawning area] for the anguillid eels, but it is also important for other reasons. . . . *Sargassum* is a holopelagic species. It reproduces without contact with the ground. So it produces these [large mats that act like] fishery aggregation devices in the middle of the ocean. When Columbus first encountered it [in 1492 his sailors] . . . thought they were near a coast when really they were in 4,000 meters of water. So it is a [unique open-ocean] environment.

It is important for a lot of the life scene history of not only the eels, but also turtles. [Newly hatched] turtles . . . swim out to sea away from predators and [into the Sargassum which] provides them with a nurturing environment. [Other species too use it] to spawn, certainly albacore and a number of other tuna species – maybe the bluefins as well. Bluefins are in the Sargasso Sea [at the time that others] are spawning in the Gulf [of Mexico]. Marlin – certainly blue marlin – spawn there. [Porbeagle sharks are known to pup in the Sargasso Sea.] Now we know why. As a result of the work the Ocean Tracking Network has done [it seems that Porbeagles may feed on the eels that have come to the Sargasso Sea to spawn].

[There are also a number] of endemic [species – adapted to life in the *Sargassum*. Notable is the *Sargassum* fish] – *histrion* *histrion*, [a small but] particularly voracious predator [whose fins have adapted so that] it can walk through the *Sargassum*.

Iconic species – [not just] threatened and endangered species – [live in and pass through the Sargasso Sea]. . . . [Scientists] think that the *Sargassum* has been there for many thousands of years; [indeed it has been suggested that *Sargassum* may be among] the oldest living organisms . . . . But certainly [a large amount of *Sargassum* sinks to the ocean floor, where it is eaten. It is possible] to use *Sargassum* as a bait to attract benthic fish at 4,000 meters. They are used to it coming down and they know what it is. It is a system which influences not just the surface but also the depths. . . . It is not just the floating canopy. But the canopy is obviously important because there are a number of fish that accumulate under it like *mahi mahi* and flying fish, which [have] threads on their eggs, which attach to the *Sargassum*. [The mats] provide a microclimate which is approximately two or three more degrees [warmer than the surrounding waters]. I never actually thought of eels as iconic, but in this surroundings I can say that they are an iconic species. [Figure 3] is a map [of the migration of the] European eels:

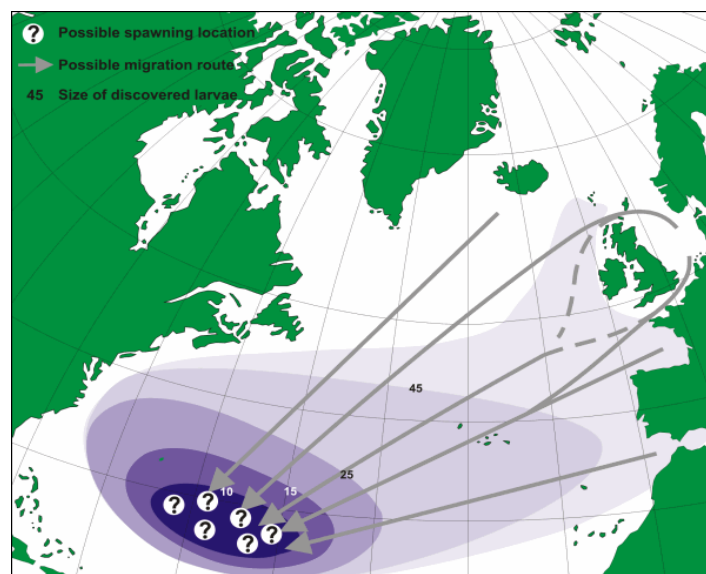


Figure 3. Possible Spawning Location and Migration Route of European Eel.

[Figure 4] is the [anguillid eel] life cycle:



Figure 4. European Eel Life Cycle.

This has been quite an important part of what we are doing.

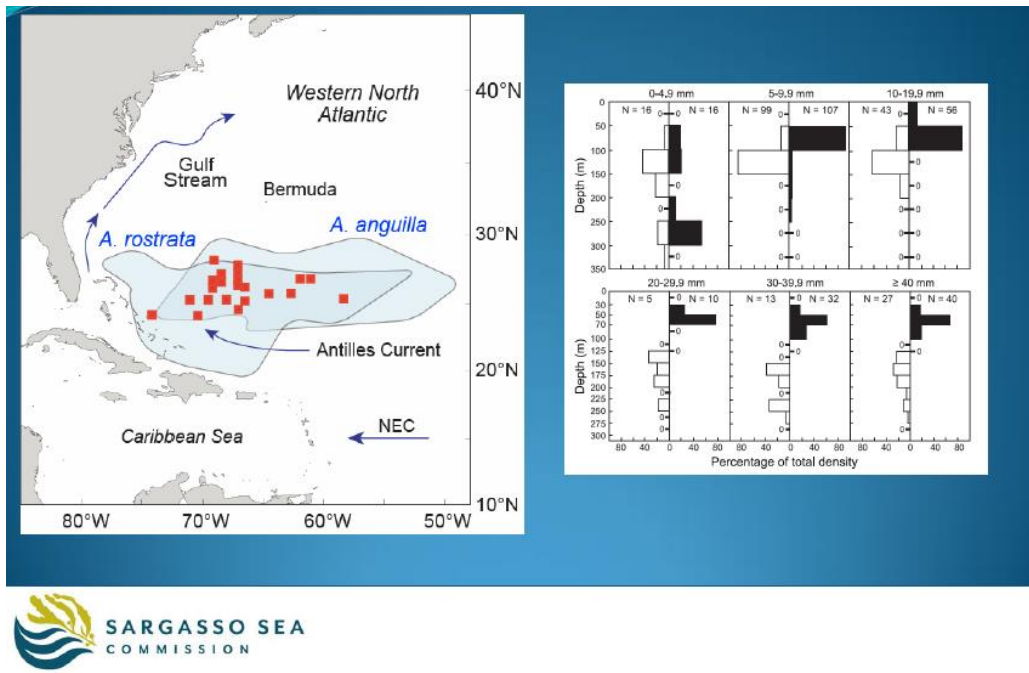


Figure 5. Distributions of *Anguilla Leptocephali* in the Sargasso Sea.

[Figure 5] is the distribution in the areas we are concerned with. *Anguilla rostrata* seems to be more to the Western side and *Anguilla anguilla* – the European eel – is to the right. But they are all just in this area south of Bermuda. So well within our key zone.

Threats: I suppose I can put [climate change] at the top [of the list]; but garbage and plastics in the *Sargassum*; pollution discharges; and we heard about the introduction of exotic species now, and if the actual crassus – the parasite – was actually [transported] on a boat through ballast waters – that [would be] great ammunition for arguments [to be presented to the] International Maritime Organization. *Sargassum* harvesting was done off the coast of the U.S. . . .

Bermuda itself is a seamount. It is a platform that is about 4,000 meters from the seabed and there are some minerals on it and some other seamounts nearby. There are [potential] threats of ocean mining, although the Seabed Authority has not actually granted any exploration licenses there and we are hoping to head them off. We have actually been doing a lot of [very collaborative] work with cable industry [to help develop best practices for cable laying in the Sargasso Sea].

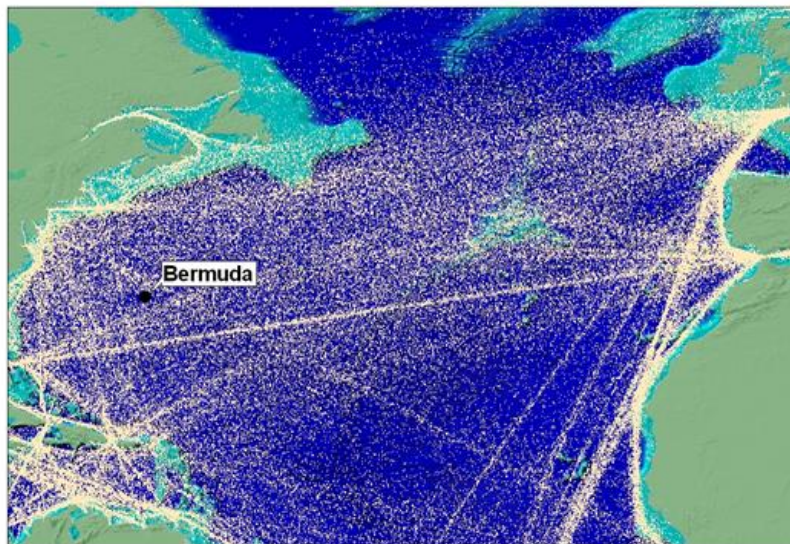
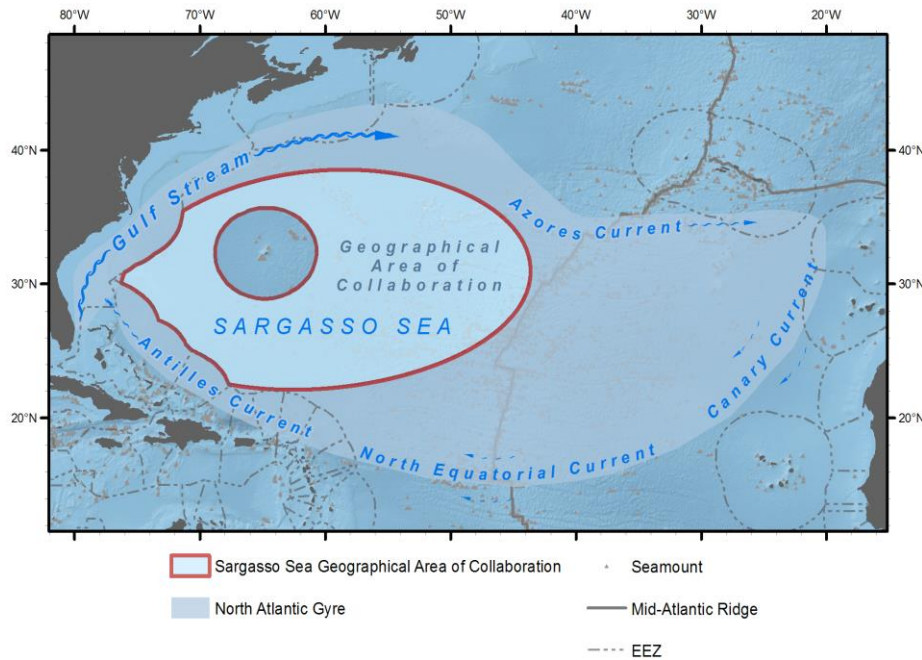


Figure 6. Traffic Across the Sargasso Sea.

Martin [Castonguay] [was telling us that when you are in] the Sargasso Sea, you do not see any other ships. [However, from a cumulative point of view there is actually a lot of vessel traffic – as Figure 6 indicates.] This is one month's worth [of vessel records] from AIS data; if you showed a year's worth, then [the whole map] would be white. . . .

The basis for the establishment of the Sargasso Sea Commission is the Hamilton Declaration, which was signed in March of last year when we brought together a number of governments. We had 5 governments sign the Declaration: the Azores; Bermuda; Monaco (who has been a great advocate of ocean conservation generally); the U.K.; and the U.S. But we also got a lot of other governments who are fellow travelers who we hope will sign [in the future]: Bahamas; the British Virgin Islands; the Netherlands . . . ; Sweden; South Africa; Turks and Caicos Islands. [We also had messages of support from] Dominican Republic and Trinidad and Tobago. Observer organizations included: the C.M.S., the Seabed Authority, OSPAR, the IUCN Commission, and the Inter-American Convention for the Conservation of Atlantic Sea Turtles. A lot of international organizations have been supporters.



*Figure 7. Sargasso Sea Commission Site.*

[Figure 7 shows] the site that we actually have [designated in the Hamilton Declaration] – it is a high seas area. If you take out the EEZ of Bermuda it is only high seas.

The system that we have set up [involves a] Meeting of Signatories – we have had one to date. . . . The Sargasso Sea Commission is a group of volunteers who are distinguished scientists and other persons with international reputations, experts in international issues [involving] high seas conservation. We have six of those now and [they] serve in their personal capacity. [After consultations with the Signatories,] they are appointed by the government of Bermuda. Then we have a secretariat, [both the members of which] are represented here! We are based in the IUCN Office in Washington, D.C., and we have a financial mechanism which is 501(c)(3) in the U.S. We are also a registered charity in Bermuda. . . .

[The Sargasso Sea Commission] does not have legal management authority because this is a political declaration, but they exercise what we call “Stewardship.” So a stewardship role to keep [the Sargasso Sea] health, productivity, and resilience under continual review. And then [we have developed] a work program, which includes the development of plans for the conservation of ecosystems, [as well as] the development of proposals for protection of it.

These are the current members: Dr. Billy Causey is from the U.S.; Professor Stephen de Mora is head of the Plymouth Marine Laboratory in the U.K., he just joined; as did Mark Spalding who is head of the Ocean Foundation in the U.S.; Professor Howard Roe is the chair and was former head of the U.K. National Oceanographic Center in Southampton; and Professor Ricardo Santos, now a member of the European Parliament and is a professor of benthic marine biology from the University of the Azores; and Dr. Tammy Trott is Senior Marine Conservation Officer in Bermuda. A nice spread of nationalities. Our first meeting of signatories took place [in October of 2014].

These are the aims: to promote recognition of the ecological and biological importance of the Sargasso Sea; to encourage scientific research; and to develop proposals to submit to existing regional organizations to promote those objectives.

[At the October meeting the Commission developed] a work programme [covering] six areas: international recognition, fisheries, impacts of shipping, impacts on the seafloor, conservation of migratory species, and then a data-defining role. So [I will refer to] each of those very quickly.

[In 2011] we produced a [baseline science] report [on the Sargasso Sea] – I hope that you all will enjoy that. That was a major operation with seventy-four collaborators from ten countries from some leading science organizations. [In 2012] we were able to achieve the description of [the Sargasso Sea] as an Ecologically or Biologically Significant Area (EBSA) [at a workshop organized by the Convention on Biological Diversity]. We actually used [the 2011] scientific study to justify this description. [The Sargasso Sea] EBSA was one of the first high seas ones and is two million square miles. So that is the lever that we then use in going to other organizations to show how it has been accepted as ecologically and biologically significant.

[For the last four years our supporting governments (U.K., U.S.A., Bahamas, South Africa and Monaco) have been able to include] some wording in the annual U.N. resolution on Oceans and Law of the Sea. It is the same wording. . . . [This year, 2015,] we actually got a whole chapter on the Sargasso Sea in the new U.N. World Ocean Assessment. It is just about to come out; it is in proof now. There are sections on coral reefs, seagrass beds, submarines, seamounts, *et cetera*; and then the Sargasso Sea – we are the only geographical area which is described. It is chapter 50. So we are delighted about that.

Fisheries: we have been doing work with NAFO, we have some achievements there in [2015, with their agreement to the] closing of the seamounts in the north of our EBSA.

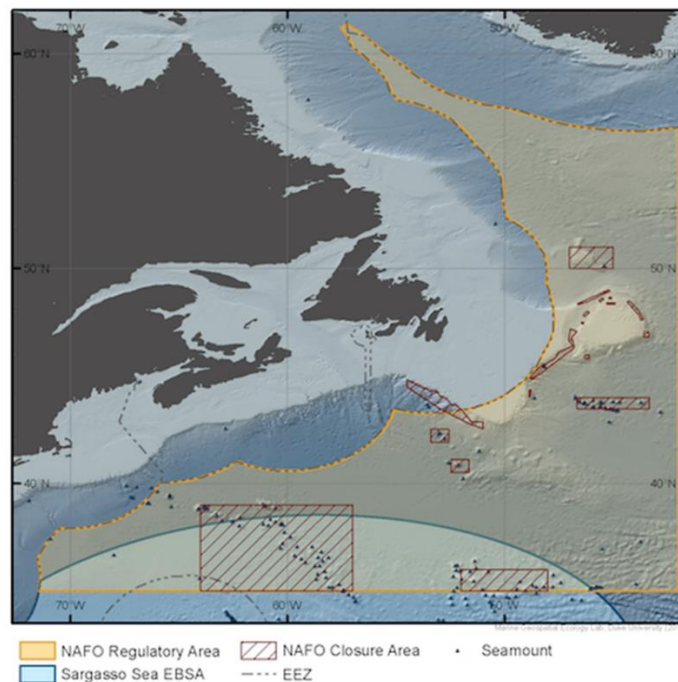


Figure 8. NAFO Regulatory and Closure Areas in the Sargasso Sea.



So, that has been a great success. We have also been working the International Commission for Conservation of Atlantic Tunas (ICCAT); this has proved more difficult.

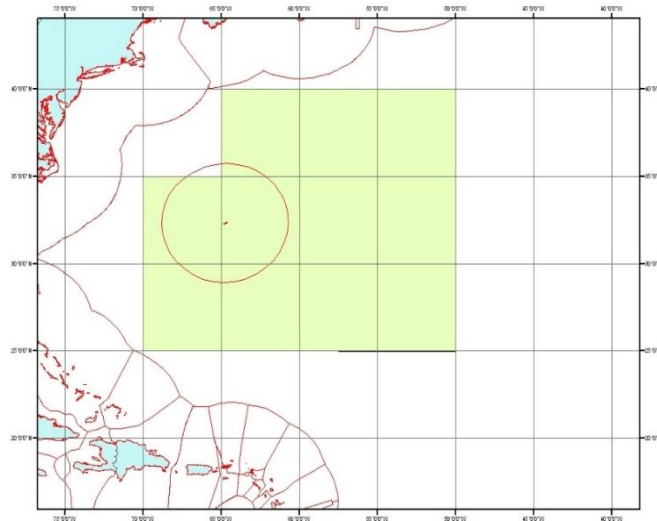


Figure 9. Map of ICCAT in the Sargasso Sea.

We have been [attending meetings] there for four years now, and we have produced a number of papers [on the significance of the Sargasso Sea for fisheries of “tuna and tuna-like” species within the mandate of ICCAT].

The International Maritime Organization (IMO) [regulates international shipping and vessel source pollution]. We have [prepared] a number of studies [on impacts of shipping and these are still ongoing]. The sorts of measures that we can be looking at at IMO include: action under the Marine Pollution Convention (MARPOL); [designation of a] Special Area, maybe; ship routing measures; reporting; ballast water control, or sewage discharge controls; those are the sort of [measures that may be possible].

With the seafloor, we have had [very positive] interactions with the cable industry.

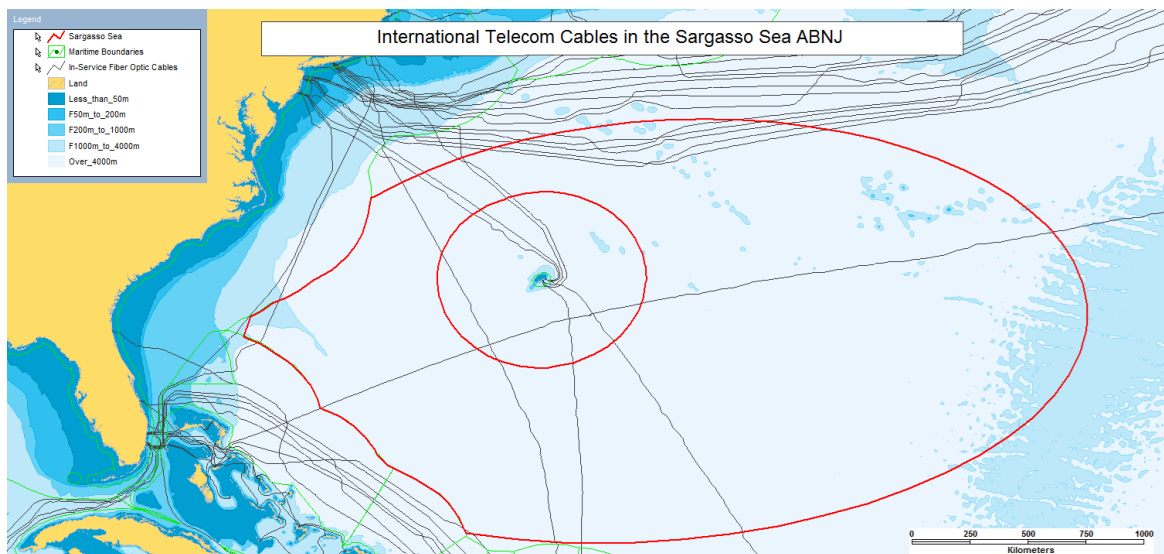


Figure 10. International Telecom Cables in the Sargasso Sea.

Surprising amount of cables there on the seamounts. There are actually 18 systems through the Sargasso Sea. We are talking [to the industry about] best practices. They are very keen for us to engage with them and to show that they are environmentally responsible. And we are pretty convinced of this. . . . [Despite their importance to international communications,] there is no international convention to [regulate the laying or maintenance of international cables].

Migratory species have been our great success. We have done a joint paper with the [Secretariat of] Inter-American Convention for the Protection and Conservation of Sea Turtles on the importance of the Sargasso Sea for turtles. . . . This paper shows that 16 turtles tagged in Bermuda all ended up on the beaches of Central America: Panama, Costa Rica, Colombia, Venezuela, and actually the U.S. as well. . . .

[However, our crowning achievement has been with the Convention on Migratory Species. In January of 2014, before the March] Hamilton meeting we commissioned Dr. Matt Gollock to do a science study [making the case for the listing of] *Anguilla anguilla* [under Appendix II of the CMS]. He did a fantastic study, which [I am delighted to report that the government of Monaco took forward to the CMS for us]. . . . Monaco is a European state, but [not a member of the E.U. Monaco, with Matt Gollock's assistance, proposed listing] to the CMS Science Council in July 2014. And then Monaco took [the proposal] to the [CMS Conference of the Parties (COP) in] Quito, where it was approved in November. And then the next step is to have a Range State meeting next year to talk about [follow up actions] under the auspices of the Convention on Migratory Species.

[The baseline studies that were prepared for our] 2011 Report [are also published within a] Science Report series. Those are all on our website.<sup>5</sup>

[Finally, I need to tell you about the work we are currently doing with NASA. Remember] the U.S. has signed the Declaration. NASA is [preparing an interactive] video portal of all of its satellite data between 2012 and 2013. This is ocean temperatures, currents, salinity, *et cetera*. Monitoring salinity from space? It sounds unbelievable, but they can do it. All this data on their portal, which you can then run through in a time series. NASA are then overlaying their data [with data from other sources – particularly animal tracking data]. We have some shark data and some tracking data on bluefin tuna data. [The plan is that the portal will be able to illustrate interactions between oceanographic processes and human and animal movement and between the latter two also.] NASA has a huge amount of data which they [have collected and] this is an opportunity for them to actually mobilize this [in a way that will be of wider benefit]. They are doing this as a partnership operation [with the Commission. This is a pilot project to see if this can be rolled out on a wider scale. We have a meeting in March 2016 to review and assess progress so far – which has been really stunning.] Thank you.

### **Bradnee Chambers:**

Thank you very much for that, David. I think that it was really interesting and I think that it is a really great interlude into the next presentations, which will focus directly on the European eel.

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<sup>5</sup> Sargasso Sea Alliance Science Report Series, SARGASSO SEA COMMISSION, <http://www.sargassoseacommission.org/about-the-sargasso-sea/sargasso-sea-alliance-science-report-series>.

First up, Matt Gollock. Matt has been working on European eels for 15 years. He is at the London Zoo where he is the Marine and Freshwater Programme Manager. He is also currently the chair of the IUCN Anguillid Specialist subgroup. For us at the Convention on Migratory Species, he is our go-to guy in the science committee for the European eels. So Matt, without any further ado.

### **PRIORITIZING CONSERVATION AND MANAGEMENT OF ANGUILLID EELS**

#### **Matt Gollock:**

I am going to be bound to talking about European eels. I am going to take a step even further back and talk about anguillids generally because I think there are a lot of parallels. I think I am probably going to be repeating a lot of what was said this morning and I think that is probably a good thing because it means everyone is thinking in the same way. Which I think is a really good thing if we want to progress. I will be talking more generally about anguillids and how to prioritize what we need to do. And also I will show a number of case studies and projects outside of the Atlantic that again shows parallels for things like threats, management. And also just a bit about the overlap between species. . . .

This is really back to basics and, so I apologize if it is offensively simple. We have been very much focused on the American eel, but it is just one of 16 species of anguillids. There are various opinions on the sub-species or sub-populations. They are generally found in temperate or tropical areas. They are not found in polar areas and they are not found in West Africa or the Pacific U.S.A. But, as we have heard they have got this very complex life cycle, but that is common across all 16 species. There are multiple life stages. They are facultatively catadromous. They are semelparous, so they die after breeding. And they are panmictic. So these are all things with complexity make management and data gathering quite difficult.

So, how do we prioritize between and [within] species about what we want to do? There are variable species ranges that overlap. There is variable regional capacity both within species – so if we look at the American eel, obviously, there is clearly data gaps as to the southern part of the range is concerned compared to the northern part of the range. And, as I am going to tell you, if we look at some of the tropical species, what we understand of them compared to the temperate species is much, much less. We have a variable knowledge base, both within and in between species. As we have heard, there [are] multiple potential threats, stressors or impacts – whatever word you want to pick. And there is actually a restriction as to where we can implement management and conservation and research. Ultimately, we will be primarily based in fresh water because of the difficulties of working in a marine environment. Again, there is varied and possibly limited resources available, be they financial, infrastructure, or human. So, this will affect what we will be able to do and how we will be able to do it. So, prioritization is potentially a big challenge, both within a species and between species. I think we need to think about conservation management of species across this range, but also in context of other species as well. We are talking about the American eel, but we are also going to hear about the European eel because there are potentially parallels and there are potentially overlaps.

As Bradnee [Chambers] mentioned, I am the chair the IUCN anguillid specialist subgroup. We use the Red List as a way of prioritizing. It is not the only way to do it, there are other ways to do it, but I am going to talk about this very briefly. It is a prioritization tool, it is an assessment of threat based on either population change over three generation lengths. So it has quite a specific

criteria on that front: threats that affect the species; what management or mitigation is in relation with that; and also what the species geographic range is. Again, this relates to what Bradnee [Chambers] was saying before, the IUCN advises taking the precautionary approach.

So far there is over 77,340 species of plants, animals, and fungus that have been assessed under the Red List criteria to date. But, it is very, very, very important to note that appearance on the Red List does not automatically mean that a species is under threat. I hear it used by a range of different stakeholders that it is “Red Listed.” That is not helpful at all because that does not mean anything. It just means that it has been assessed under the criteria. The criteria could indicate that the species is actually in a good shape. So “Red Listed” is not a term that I enjoy use of.

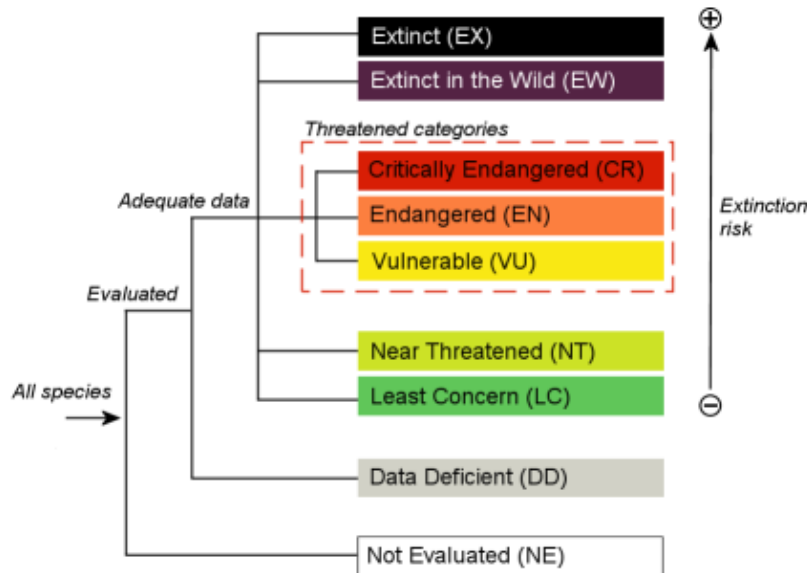


Figure 11. Red List Categories.

[Figure 11 shows] the Red List categories; [including] the threatened [categories]. What I wanted to point out is that “endangered” here is very different than “endangered” where the ESA (Endangered Species Act) is concerned. It is very important that the two are not likened because the criteria for them is very, very different. One that I would like to highlight – and I think that this sort of comes back to slightly what I was saying before about prioritization – is that “Data Deficient” means that there is not enough information to carry out an assessment. I personally think these are the ones that we really, really need to be concerned about because if there is not enough information being gathered about them, then it is really difficult to determine what the status of the species is.

The *anguilla* group under the IUCN was established in 2012. None of us are employed by the IUCN; we are just the sort of band of go-to experts as far as eels are concerned. We are not paid for it by IUCN. Basically our role is to catalyze research and conservation initiatives that are going to help to fill some of the knowledge gaps that we have identified as part of the assessment. It was an assessment workshop carried out in 2013. I will just quickly summarize: there were four species that were in the “Threatened” category. “Threatened” is basically one of these three (critically endangered; endangered; vulnerable). One was listed as vulnerable, which is *Anguilla borneensis*. There was not very much data in relation to that so I think it is possible that it is going to be a priority to collect more prior to the next listing. Two were listed as endangered: *Anguilla*

*japonica* again compared to *Anguilla rostrata*; there is much less information on *japonica* but more than *borneensis*. *Rostrata* is listed as “Endangered,” but we sort of posited that if the situation was to continue as it is at the present then it is very likely that it would drop to “Vulnerable” because . . . the population trends were such that it looked like it was improving. The same would apply to the “Critically Endangered” European eel. We felt that the situation is probably better than it was when it was last assessed and, if things were to continue in a positive way, then it might be that we would look to downgrade it. But, again, that is all going to depend on the information we get, what is collected in the next five years until the next assessment. Four are found to be “Near Threatened”: *bengalensis*, *bicolor*, *celebesensis*, *luzonensis*. These are primarily tropical species and is important to point out that the temperate species here are the ones that were in the threatened categories. Two were listed as “Least Concern,” so these were ones that we are not hugely concerned about because we think their populations look pretty good. Those are *marmorata* and *mossambica*. Three were listed as “Data Deficient.” As I said, these are the ones that I want to take under my wing and doing something about. These are *interioris*, *megastoma*, *obscura*. Again, these were tropical species and I think . . . ones that would be really helpful for us to get a better understanding of.

After that process we wanted to go back and look at what are we going to do with this information as far as prioritization of the species is concerned. The four “Threatened” species, primarily, are more temperate – it was only the *borneensis* that was a tropical species. Generally, what we found was, and again this comes down to prioritization, there is more capacity and more baseline data for the temperate species and there is probably better management in place for these species than the other ones. And limited resources – how much do we want to put in as far as global conservation is concerned. Most of the temperate species are probably reasonably well-managed within their own range states. But that said, there are range knowledge gaps – for European eel: Northern Africa and the Mediterranean is much less understood than some of the northern latitudes. As we heard before with the American eel, the southern portion is much less well understood compared to the U.S.A. and Canada. For all of the species more escapement studies would be hugely helpful, as far as general science is concerned. And when we looked at the threat and impact analysis for the species there is still – and again this comes back to what many of the speakers said before – that there is a crude understanding of how these stressors or threats affect species individually, but also synergistically and cumulatively. So I think getting a better understanding of that would be really important. I think this is, as David Cairns pointed out today, this is what is so incredibly important today: stakeholder coordination. For many of the species, we have found that there was lacking national and international stakeholder coordination and getting everyone in the room and talking to each other is so important with regards to actually to making things happen for the species.

If we look at the “Near Threatened” species, the one that I would pull out is the *Anguilla bicolor* because this is one that over the past 5 or 10 years perhaps there has been an increasing demand for it because it is a potential replacement for the Japanese eel. And the decline of the Japanese eel is certainly of the countries in southeast Asia, the *bicolor* is being exploited in higher levels than it was previously.

**David Freestone:**

Can I ask where it is found?

**Matt Gollock:**

*Bicolor*? We are doing work in the Philippines on it. It is in Indonesia. So it is in that sort of part of the world [and in countries bordering the Indian Ocean.]

For the “Data Deficient” species, primarily tropical, much less capacity there and a huge knowledge gap. Even identifying these species can be difficult and there is often confusion with some of these. The understanding of the range is very vague. There are no population studies to date and, again, with threat and impact studies, there is very little to date. These, certainly as far as the efforts my colleagues are looking at, this is where we are going to be focusing our efforts on.

I want to [discuss] a couple of projects that my colleagues and myself are involved with, in regards to some of the species outside of the Atlantic that hopefully will have some parallels to what we are talking about today. The Japanese eel, as Mitch [Feigenbaum] said previously, there has been a long cultural association with the eel. Historically, there is high consumption of them in the days where they typically eat eels. But this, from data that has been collected recently, does appear to be declining. Again, as Mitch [Feigenbaum] said, the processing of these eels, from live to fillets, is something quite staggering to behold. I watch this gent do dozens and it was amazing. It is important to highlight how they use every part of the eel or the deer, whichever expression you want to use. The heads get used, the guts get used, the fillets get used, and they even deep fry the spines and eat them as bar snacks. This is hugely engrained in the country. In fact, about two or three years ago I heard that they made an energy drink that had essence of unagi in it. It is something I am not sure I want to try, but it just highlights how engrained in the culture it is. . . .

What is important to highlight, as far as the consumption of Japanese eels is concerned is that it is the preferred species in Japan; it is seen as a better quality. However, other bi-colored species are also consumed. So American eel, European eel, and more recently *Anguilla bicolor*. [But] the fishery is just one thing that might impact this species.

Habitat loss and modification is a big issue as far as the Japanese eel is concerned. There was a very interesting paper published recently that showed the decrease in habitat availability across the species range using satellite imagery which I would recommend reading because it is very interesting. Pollution is an issue. Barriers to migration is a big issue. I visited Japan last year and, speaking to some of the fishermen out there, they were saying that some of the building of barriers has actually changed the habitat enormously and they cannot get bait for their longlines to catch the eel in some of the estuaries. And [the fact] they cannot get bait [could] indicate that there is potentially less of a food source for the eels themselves. As we have heard before, changing [oceanic] conditions may very well be having an effect on the species. I am going to talk about work in the Philippines soon, but certainly over the last 20 years the presence of the Japanese eel, which used to be reasonably abundant in the Philippines, has basically decreased to what we call “vagrant,” which means it occasionally appears. We think that could be due to ocean currents changing.

So, basically, the point of this story is: last year myself and my colleague Kenzo Kaifu, who worked at the university in Tokyo, had felt that the key stakeholders, as far as Japanese eel is concerned, had never sat in a room and talked to each other. Which seemed crazy for a country where it is so culturally, economically, and biologically important. We basically organized a meeting of 50-60 people and that was the first time that it ever happened. And it was quite a big deal. They had a second one in May this year. . . . Basically, this has got the ball rolling into the discussions about what conservation and management prioritization is needed over there. There

is talk of creating a species action plan that will look at better data collection, potential barrier mitigation, habitat restoration, and fisheries management. Which, again, are all of the sorts of things that we have been discussing today.

I want to talk a bit about the work of eels in the Philippines and why and how we got to the point to decide to work in this place. It seemed like a good spot to work because our understanding [was] that there were 5 species [there] – more recently, there are studies that indicate there actually might be 7 species of eels found in the Philippines. So if we could do some studies there we might be able to kill five eels with one stone. [Laughter.] Primarily, tropical species and the species that we don't have a huge amount of data on. In more recent years, there has been more international trade [from the Philippines], and that includes *Anguilla anguilla* going through there. Now this is customs data which can be notoriously variable, so maybe don't look at the figures, but at the proportions. Prior to the closure of the European eel export, France was a big export, Japan was a big export. If you look here at the Philippines in about 2011-2013 the proportion increased drastically. Again, this customs data is notoriously variable so I would not take the figures as 100%, but, just looking at the changes, I think, indicates that the export is pretty huge in comparison to what it was. The Philippines was one of [countries] filling the gaps once the European eel had stopped being exported. Again, it is important to highlight from the data that Gail [Wippelhauser] showed that the price per kilo was possibly as high as \$5,000 per kilo in the US. This [has also been anecdotally proposed to be] the case in the Philippines. The average fishermen in the Philippines might get \$50 or \$100 a month. The idea that they could get \$5,000 for a kilo of glass eels, that is pretty life changing for some people. So there was suddenly this enormous demand and the government and the regulators were not ready to have this massive shift in demand and there was also very little understanding of the situation of the eel populations and the species they have generally. But also, the freshwater – obviously freshwater is an important habitat for eels. . . .

Basically, we decided it would be a good idea to collaborate with people that would hopefully help to make a bit of a change in the Philippines. That would mean that people could continue to make a living from catching the eels, but also that the eels would be better understood and be able to survive in perpetuity. So we collaborated with TRAFFIC and the Philippines Bureau of Fisheries and Aquatic Resources (BFAR). And this was in the northern Philippines where initially we had understood the fishery to be, but that sort of shifted.

We basically had 5 major goals: to collect baseline biological, but also sociological data; to better understand the freshwater habitat of the region and carry out a very rudimentary threat analysis; look at whether there should be policy development to try and improve the situation; ensure that there were sustainable fisheries management, both for the species and the people that relied on it; and look at the idea of community-based eel farming as a sort of potential livelihood option. In the past 5 years, there has been a big influx of people from outside of the Philippines trying to set up eel farms to capitalize on this. It was our feeling that, if that is going to happen, then let's work with the communities to make sure that most of the benefit goes there, as opposed to it just going outside of the country.

With regards to policy development, we are about half way through the project and we are advising on the national government with regards to improved chain of custody and associated transparency of that, and to also improve national and international engagement because, as they say, this is very recent – the scale of this export – and there is not much communication that goes inside of the country but also outside of the country, and we are trying to better increase that communication. Certainly in the northern part of the Philippines there is a mixed catch. They get

more *marmorata* and *luzonensis* than *bicolor* and that is what the major demand is for. This highlights again how the influence of the ocean can have a big effect on things that are happening on the land – in that it appears that the composition of the catch has shifted in past 3-4 years. In the northern part of the Philippines they used to get *bicolor* in reasonably high numbers, but that has dropped right down. So the fisheries have shifted to the south Philippines where they get a lot more *bicolor*. Again, that shows you how oceanic changes can have big effects on freshwater, but also socio-economics.

We are working with a lot of the communities to instigate simple fisheries management, both for the benefit of the species, but if we can collect data on what they have caught and how much, perhaps some effort data, that will be hugely beneficial to the regulators and the managers with regards to making sure the species are sustainably caught. And we found out from our socio-economic experts that fisheries are very opportunistic and that links to external demand. Again, that increased communication between countries – between the Philippines and other countries in East Asia – is going to be really important. What we did also find is that many fishers engaged in eel fishing are probably below national minimum wage in the Philippines which is not particularly high – it is around 120 dollars a month. So when the eels are not getting a very high price – which, at the moment, they are, we are certainly not in the northern Philippines where we were studying – they just are not going out and catching them because there is not the demand; most of the demand has gone to the southern part.

Again, this idea of improved coordination – we are working at the community level to make sure that coordination of people within villages and at the provincial and national level is improved through the creation of these organizations called Fisher Folk Associations. Again, it does not matter if it is national stakeholder meetings in Japan or whether it is local coordination at the village level in the Philippines, that sort of stakeholder communication just seems key to me. This will also hopefully get and insure a more equitable supply chain because, basically, they are at the bottom of the ladder at the moment and they are not really seeing a lot of the benefit of all of these high prices.

With regards to the freshwater habitat, what has been really interesting and it sort of comes back to the talks just now, is that there are actually very few large barriers on the Cagayan River in the Philippines, which is the major river in the Philippines and the one where the fishing is taking place. It is one thing that we don't have to worry about which is quite nice. I am sure that will change over time, but when we think about the Atlantic, barriers to migration is often a massive problem and this is not one here. So there is good connectivity. Habitat degradation is a big problem and there is a huge slash and burn activity; and a lot of agriculture goes on. The Bureau of Fisheries and Aquatic Resources decided in their wisdom to stock tilapia in the rivers and we just shook our heads. Anyway, when we did our surveys of some of the sites where eels were suspected to be, it was generally tilapia we found in huge numbers. So that could be a species that is out-competing eels in places where they would normally thrive. Pollution from communities is a big problem. There is no trash collection in some of these rural areas so that just goes into the river. With regards to our feasibility study, I think that ourselves and a lot of big companies [that] have moved in from outside find that the tropical culture is very challenging. I won't go into specific detail, but we are not having a massive amount of success on that front.

To conclude: prioritization, certainly in the global context, is really important. Stakeholder coordination and communication is essential. Hopefully this is indicated that species and their management are potentially linked nationally, but also globally. Trade is constantly changing its impact. Oceanic currents – there is not necessarily something that we can do about it – is something



that we have to be conscious of when it comes to management and conservation. So, Sargasso Sea is one. But in the Marianas you get *Anguilla japonica* and you also get *marmorata*. Changes there can have effects in fresh water, which is where we can ultimately manage the stocks. I would argue that it is important to be mindful of other species. Tropical species are in serious need of attention – that is somewhere where we are going to be focusing our efforts. I think, if there are opportunities for multi-species research, these are opportunities that should be taken. So, in the Philippines there are potentially 5-7 species we are looking at. Two of the three [“Data Deficient”] species are in French Polynesia and we are trying to start a project there. Alan [Walker] might mention that in a minute, but this year he chaired a meeting that was looking to develop NDF (non-detriment finding) criteria for the European eel for CITES, but it was very much felt by the group that this could be replicated by the species. I know that CITES has been discussed with regard to the American eel. So, this might actually be a very useful tool that would not require much modification to be useful for the eel. . . .

Finally, I would just like to say that I am presenting on behalf of so many people: my colleague David Jacoby, who is the leading author on that paper, the people of TRAFFIC have been very key in looking at the trade data, and all the members of the *anguilla* specialist subgroup have been very supportive of sort of developing the assessments and helping within that. Kenzo Kaifu in Japan – he is driving forward the Japanese eel forum. And the team in the Philippines where they are basically doing all the work I presented. I am really just a mouthpiece for all the good work that they are doing. And also the Bureau of Fisheries and Aquatic Resources. Finally, I would like to thank the Sargasso Sea Commission for inviting me to come and talk and also supporting CMS. Thanks very much.

**Bradnee Chambers:**

Thanks very much, Matthew. That was excellent. . . .

Now I have the pleasure to introduce another leading expert in Europe: Alan Walker. Alan has a dual role: he is in the CEFAS group and he manages the group for marine and freshwater ecosystem research. He also has a role in terms in policy advice to the U.K. government and the Division for Fisheries and Ecosystems.

**KEY POINTS IN THE RECENT MANAGEMENT OF EUROPEAN EEL ACROSS EUROPE AND  
BEYOND**

**Alan Walker:**

I will get my acknowledgements out of the way first of all. Thanks very much for inviting me to come here and speak and for everybody for being here. CEFAS is my company and ICES (International Council for the Exploration of Seas) is another [body] that I am involved with. Those logos are on the first screen and you will never see them again. Everything that I say from now on is me, and me alone. . . .

I will talk about giving an introduction and a little bit of the context about the European eel, where we are today, how we got there, and the future. The future is mostly about what are some of the challenges and what might we do about them.

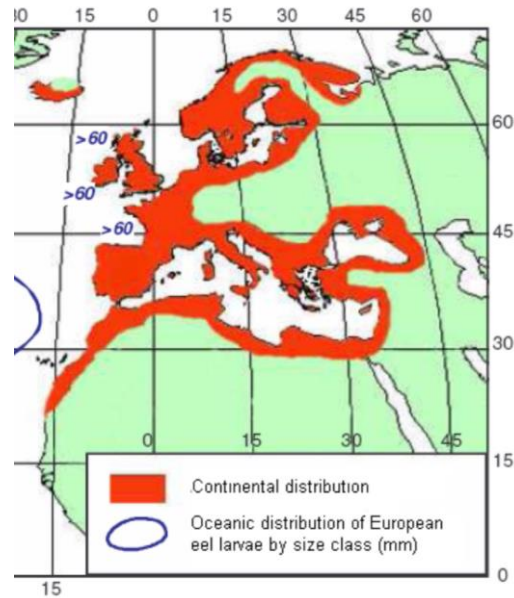


Figure 12. European Eel Distribution.

A little geography to start with. You have seen the range of your American eel and some of the other ones. [Figure 12] is the range of the European eel. You can see that it extends from Northern Africa to the top of Scandinavia and all the way across the Mediterranean. The point that I want you to know is that the blue countries here is Europe. So the European eel is beyond Europe. We always have to bring people back on that. The green countries [in Figure 12] are the ones that also have the European eel, but are obviously outside of Europe and mostly in the Mediterranean, but also Norway and Iceland. Is that not Monaco there?

**David Freestone:**

The Norwegians would claim to be Europeans as well. They are not members of the E.U. but they are European.

**Alan Walker:**

Yes. That will become important. Just a bit more of an introduction. The European eel we have heard a lot I think about the *rostrata* and other species, but we have got the diversity as well. And life history. In the southern range, in really simplistic terms, you have got relatively young silver eels typically four to eight years before they go back to the sea. Typically, males dominate. But I find as soon as you say something someone will say that is not the case somewhere else. [Laughter.] In northern areas, typically females dominate and they are definitely a lot, lot older. Ten to fifteen years is not uncommon; ten years is certainly average.

There is a diversity of impacts. . . . We have got our barriers and in a lot of cases, tidal controls. We have got our parasite – the *Anguillicoloides crassus* inside the eels. We have got the predators. I have [included] the heron . . . . Predators is a controversial subject in Europe because some countries have decided that they are a human problem and other countries say that they are a natural problem and, therefore, the humans do not have to do anything about it.

There is a diversity of solutions again. We have fisheries controls on both commercial and recreational fishing. We have got a whole host of different definitions of recreational fishing and I do not know how they translate to North America. We have got turbines, pumps, and screens. Trap and transport is one that is being used in a few places where they actually – particularly for silver eels – they catch them up off of dams, load them on lorries, and take them either round that dam or around all the dams and put them back in. Eel passes we have heard about. . . . We also have stocking as an option in some places.

We have a diversity of issues and the key fact is that there is a range of issues all the way across the distribution of the European eel. I think someone said it here today already, it is never be the same thing everywhere. It will be something that is important in one place, and something else that is important elsewhere.

The present situation. I do not need to say any more on [panmixia]. For the European eel, the whole stock status assessment is done by ICES (International Council for the Exploration of the Seas). It focuses as much as it can on the entire distribution range. Management within the E.U. is set and driven by an E.U. regulation, an E.C. regulation, which sets the principles and then the countries, the member states of the E.U. are supposed to follow them. Management outside of the E.U. is, in some cases, follows along that for various reasons and in other cases does the wrong thing or does nothing. We have heard about other international drivers and I knew that we were going to hear about them so I did not spell them out. CITES, the Red List, the Convention on Migratory Species, and some others.

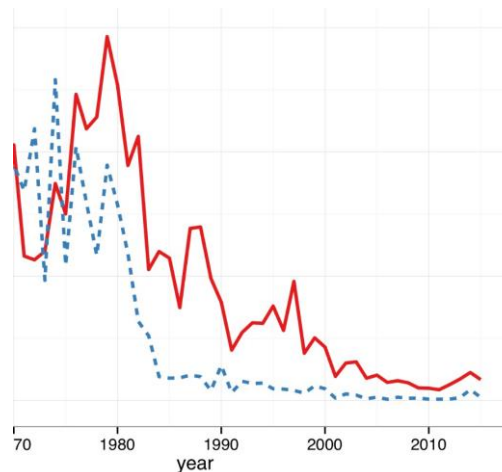


Figure 13. Stock Status of European Eel from Recruitment Indices.

The stock status from ICES for the whole stock is based on recruitment indices. The red and the blue lines [in Figure 13 are] the two international recruitment indices we have. It goes back to the 1950s, but I cut it off at 1970 to fit it onto this map. Honestly, no matter where you cut it off someone will not be happy. [Laughter.] But the crucial point is that we have set a baseline around the 1960s to the 1980s. Now the recruitment index, which is a relative scale, is down a few percent. That little blip you see that is going up is to compare with your American fisheries, it was going up for the last four years. But this year, hot off the press, it is not even printed yet, it has gone back down a little bit. That is based on time series data from Spain all the way to parts of Scandinavia. So it is not one fishery in one zone. Those fisheries extend from October-November all the way through to April-May depending on where you are. So it is quite broad. But, the other reason I wanted to show you is remember the eel is down here in Northern Africa to across the far

side of the Mediterranean and all the way to the top. And, yet, the recruitment indices we have are just in this area.

**Mitch Feigenbaum:**<sup>6</sup>

That is only glass eels?

**Alan Walker:**

Those are glass eel, elvers, and a few young of the year yellow eels in the Baltic. The glass eels actually do not get into the Baltic, they have actually gone a bit further since then. But most of it is glass eels. And that is the point. The stock status is based on recruitment and our recruitment indices.

Within the E.U. we have regional management. As I have said, the E.U sets the principles and then the countries have to do their own thing to go with those principles. Within the countries themselves, most countries have decided to break their area down into what we call river basin districts/regions. For England and Wales, we have got 11 river basin districts. Eels are assessed and managed at that level. In Ireland we have 5 or 6 in the Republic and 3 in Northern Ireland as well. France has a few more. . . . That is how we go from the sort of the international down to the local effectively.

The regulation that kicked this all off came into power in 2007<sup>7</sup> and was, I will show a timeline in a little while, but it was debated long and hard before that. It required that in 2009 that E.U. member states should have developed and had approved eel management plans for each of these regions. They had to define their eel producing habitat. The crucial thing there was if the country said “we don’t have an eel producing habitat,” if it was agreed, they were then exempt. They had to estimate their silver eel escapement biomass – so, the weight of silver eels that leave their rivers today and at some time in the past. And the some time in the past is especially challenging. The basic principle was that if at some time in the past if humans had not been involved what would you expect to have come from eels? That’s variously been interpreted and translated as “pristine” or “pre-1980s.” My lawyer friends will understand this, my experience has been that the regulation was published in all of the E.U. languages. From speaking to my colleagues in different countries, there are a whole number of different interpretations. So, what I read in English is not the same as what my French colleague reads in French, and that has been a challenge. We also have to estimate what our human impacts are now, take measures so that we have silver eel escapement which is at least 40% of what it used to be. Not 40% of what it is now, but 40% of what it used to be. Those are completely different things and it gets confusing. And we have to report progress. The first report was to the commission in 2012, there’s another one sitting on their table now, another one comes in 2018, and then we move to 6-year reporting cycle. If a country said “no we are not going to do that,” what they had to do was to cut their eel fisheries by either 50% catch or 50% effort equivalent. Denmark, for their marine zone, said “no, we are not going to do that” and they cut their fisheries and that was accepted. And the last thing, this 65% – that was important because there is another stipulation that if you have a glass eel fishery in the country, by now 65% of that catch has to be made available for stocking. So, it does not all

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<sup>6</sup> Director, American Eel Sustainability Association.

<sup>7</sup> Commission Regulation 1100/2007, Establishing Measures for the Recovery of the Stock of European Eel (2007).

go to aquaculture. In fact, only 35% of it can go to aquaculture. The rest of it has to go for stocking, or has to be made available for stocking. But they never defined what “made available” really means. And especially since if it is made available for 3 days and then nobody buys it for stocking, nobody has ever challenged what then happens to it.

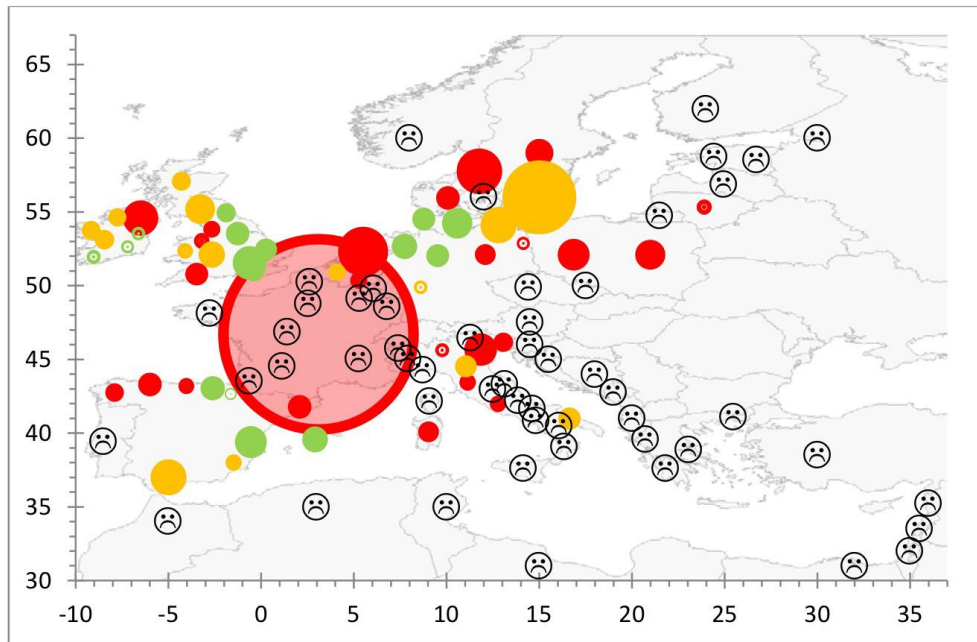
So, how did we get here? The time series, again, back to the 1970s – and this is to just show you how long it takes to do things. The crash in recruitment in the early 1980s, and I am not saying that nobody noticed it up until then, but it was not until 1988-1989 that ICES started to say that there is something really wrong here and somebody needs to do something about it. Lots of people really were saying that before, but that is when it was written down. Then to 2007, before the E.U. regulation came in. It took that long because in the early 2000s they first tried within the E.U. to say, “we will impose top down control and say you have to close your fisheries or got to do something or everybody has to do the same thing.” After a lot of debate we realized that it is not the same problem in every place. Every country and every region has their own problems and imposing something top down like that would not work. It would not be fair on everybody and it would not be a plan. They had E.U. top down, and they gave up on that. So they went to the idea of E.U. principles. The parent says, “this is what I want you to do and you can go away and do it however you like. Find your own way, but do it.” So, that was the regulation. Eel management plans in 2009. We have had a report in 2012 and another one in 2015.

Just to give you a little bit more on how the assessment and the management come together. ICES assesses the stock status on recruitment, the regulation sets the target and principles, and the countries decide how they want to achieve that, and they decide what their target is as well. We have a variety of solutions that have been imposed. Ireland, at least, and a couple of other countries just said “okay, it’s too much trouble and we are just going to close all of their fisheries.” And they did that, they closed all of their eel fisheries. And the fishermen did take them to review for that, but it remains that way. England and other ones have focused on restoring habitat and opening up areas for eels. Sweden, in particular, have a lot of dams and therefore have done a lot to bypass their hydro power. And a lot of countries are actually looking at stocking and using that as their principle management option.

The assessment framework itself is the E.U. commission who asks ICES (International Council for the Exploration of the Seas) to get them annual advice on the eel stock status. And the member countries of ICES submit experts and submit data that now all goes into the pot to give a whole look at stock assessment. E.U. members in ICES can get paid to do that. So they can attract funding in order to find and collect that data. But, at the same time, if they do not do it, they get penalized, they get fined. The countries that are not in the E.U. do not get paid, but if they do not do it, they do not get fined. So, they do not have a carrot and they do not have a stick either.

Now the stock assessment – this is where we are – I have said several times that the stock assessment at the moment is based on the recruitment alone. There are other things in the pipeline, but they are not there. The regional assessments through these eel management plans produce, as explained, the silver eel escapement biomass – how many of the adults are going into the sea? And we have calculated an equivalent of mortality on that as well. The problem with having a biomass target is with eels, and especially with eels that can be very old, if you effect a change on the glass eel it could take 30 years before that has an effect on your silver eel biomass. What are you going to do? Are you just going to sit there for 30 years and say, “it is going to be okay?” *[Laughter.]* So, if you have something that just measures mortality, just an estimate of how many you are killing, you can change that tomorrow and say tomorrow, “we are killing half as many as we were.” But this is all regional and we still need to get to the whole stock assessment. So ICES is working

on how we combine all these things together to get the whole stock assessment. They are also working on the classical stock recruitment relationship.



*Figure 14. E.U. Regions and Biomass and Mortality Targets.*

The thing about the biomass and mortality targets – the regional stuff – is that I have said the countries in the E.U. have to do it and everybody else does not have to do it. All the sad faces [in Figure 14] are all of the regions of the E.U. distribution that have not provided biomass and mortality targets yet. You can see there is an awful lot of sad faces there. So there is a lot of the range of the eel that we do not cover. The color dots are where we do have data. Where there are reds, they are not achieving target. Where they are green, they are achieving target. . . .

The stock recruitment relationship, which is the way that most marine fisheries are managed and assessed, is ideally the way we would go with eels. We can do one. You know recruitment on one scale, and biomass on the other scale. We have lots of points and you can draw your lines through it and argue about what kind of curve fits all those data, but the ultimate problem is that the data that makes up the biomass and the recruitment is really shaky. And nobody who wants to make a decision yet is prepared to stand behind these data. We still have to keep working on that. Which is why we are still on simply on a recruitment basis.

To conclude, to look at the future and the challenges. It is my personal opinion that the international regulation has brought action. I do not believe that all the countries within the E.U., or even outside the E.U. as well, would have done as much as they have in the last few years if there was not some sort of overarching drive. In Europe, we have had the eel management plans the progress reports. Outside of Europe, we have had management actions, we have had countries developing eel management plans as well. And in some cases, that is because they are hoping that if they have got an eel management plan it will help to facilitate trade into and outside of Europe, so they will be able to increase their fisheries and develop business. Whether it will or not will be tested.

Challenges remain, some in these national estimates, which, effectively – I do not know if this translate to North America – but to us at the moment, we are comparing apples and oranges. So we have no idea how to do that, how to bring them together. The question of addressing all the impacts: the eel is somewhat different from all other ICES marine species in that we have accepted that it is not just fishing. There is hydropower, there is habitat loss, there are all these other impacts and we are bringing them in. Whereas, particularly in a marine environment, they are getting better, but they are just focused on fisheries. But, we have left all the countries to admit what impacts they have got. And, when you look at the comparisons, you sort of think some countries “you have got hydropower or you’ve got pumping stations and you have only taken account of effect of pumping silver eels going down and not on yellow eels going up.” So some things are not quite there. The way the data and the methods have been applied has not been peer reviewed in most cases. So that has to be done before we can be sure. That is what brings about the call for standardization. Although the commission has said to the countries, “go off and do your own thing,” they realize now that everybody has done their own thing and it is difficult to compare them and bring them together. So, there is a bit of a call now for actually saying, “yeah, okay that is fine, but now go and do this thing that we want you to do so that we can understand what you are bringing us.”

Finally, there is a drive from some to reward the countries who are making an effort on this by at least relaxing the control, but punish the other countries who are doing nothing by increasing the control on them. But the eel is bigger than Europe and it is bigger than the EU and we have to focus particularly on the ICES whole stock assessment. We have to think about the whole stock. We do not know whether the eels from Portugal are important compared to the eels from Sweden and, until we know that, we cannot say, “Portugal do this thing and Sweden do something else.” Thank you very much.

**Bradnee Chambers:**

Thank you, Alan. That was really great and I think it makes a great comparison especially at the policy level. I hope we can maybe get some questions in. Who would like to kick off?

**MODERATED DISCUSSION AND QUESTION & ANSWER PERIOD**

**David VanderZwaag:<sup>8</sup>**

Maybe a question to Matt: given your work in Asia and Japanese eel in particular, have you followed at all what has been happening in Asia currently with management across borders? Look at what Europe is doing. So I guess the question in my mind is: has anything occurred in the Asia context to deal with the regional distribution issue and the eels’ sharp decline? For example, even bilaterally between countries on a regional basis?

**Matt Gollock:**

There was a joint statement put out last year. I think it was China, Taiwan, Japan, Korea that put out a joint statement saying that they would look to reduce the input of Japanese glass eels

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<sup>8</sup> Professor and Canada Research Chair in Ocean Law and Governance at the Marine & Environmental Law Institute, Dalhousie University.

to aquaculture in the region and they made a vague reference to possibly taking the same route towards other species as well. It was more than that, but I think I have distilled that correctly. So, there has been a bit of movement which is good. Again, I think it sort of comes back to if people actually communicated with one another across borders. I think there is movement – there is a group called SEAFDEC – that is East Asia, certainly the Philippines are involved in that, and I think Indonesia and Malaysia. So there is this communication with that. The eel profile is being raised in those discussions but I certainly would not class myself as an expert.

**Steven Shepard:**<sup>9</sup>

Are there any actions in Europe targeting the *anguilla crassus*?

**Alan Walker:**

No, there are not. I suppose the biggest problem is that you do not know which eels are infected until you open them up. At which point, they do not spawn very well. [Laughter.] It is kind of an assumption that is going everywhere and there is not a lot that can be done about it slowly getting everywhere.

**Steven Shepard:**

Any additional research targeting the migration impacts, perhaps?

**Alan Walker:**

I do not [believe] so, I think that has almost done its thing. When we did the satellite tracking in the oceans early on, the hope was that we would have some metric for the eels that we tagged to find what their parasite was and what their contaminate level was. But it was very difficult to do something like that without feeling like we had such a bigger impact on the ability of the fish to get to the sea or to get to the ocean. So, all that we could do in the end was take silver eels from river basins where we thought there was little or no *crassus* and tag them and then tag others from areas where we thought there was a lot. We did not get enough returns to make [those] comparisons.

**Matt Gollock:**

One of the big problems with regard to load is that you can perhaps have an individual that has been recently infected and have a high load, but often the problems with the swim bladder are associated with long term chronic infection, when fibrosis causes real thickening of the lumen and that prevents it from working properly. So even if we knew of the load of that particular individual, we do not have a[n] . . . assessment of the infection history, which is potentially more important than looking at any particular one at any time. It is useful to get a sense of the prevalence and intensity within rivers. But, ultimately, it is the long term chronic infection that is going to potentially have the most impact on any migration.

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<sup>9</sup> Maine Hydro Licensing Coordinator, U.S. Fish & Wildlife Service.



**Martin Castonguay:**<sup>10</sup>

I was surprised to see the number of unhappy faces at your national plans [in Figure 14]. In fact, I did not see very many happy faces. Is this improving? If you had put it last year, would it have been different? Is it improving through time or is it really stuck and does not look like it is going to work?

**Alan Walker:**

Unfortunately, it is about two months too early to answer that because the 2015 reports to the European Commission will see if we can assess that and we will get them at the end of November, so next month. I expect that countries within the E.U. have done better and I know that some of the countries along the Mediterranean are doing better. But everything is quite slow, so I do not think we will get a big change.

**David Freestone:**

I have a comment and a question. The comment is, on your last point, that the E.U. method of legislation is that, as you suggest, [the Commission] lets the E.U. member states [take action] themselves and if they [do not do a good job the Commission publicizes that]. So, it might be that [things will be changing after] the next assessment. That is just a comment. The question is: restocking. Jim [McCleave], this morning was making a real important point about the differences in populations and genetics. So, restocking, he was suggesting [poses] some [real] issues with that. Has that been looked at for the European eel?

**Alan Walker:**

It has been looked at to some extent, but unfortunately like most things with the eel it cannot be conclusive. There is sufficient body of evidence with restocking in regards to the European eel that can be argued in either direction. Most of the restocking, historically, has been to help fisheries. The questions are: will those silver eels actually get to the Sargasso? And the other one, which is crucial, is: if you had not caught the glass eels in the first place, how many of them would go to the Sargasso? So are you better off taking them out of somewhere or leaving them where they are? Which is what we call the “net benefit question”: is it worth fishing them in the first place? And we just do not have the answers for that. There is a regular challenge about whether the stocked eels would get to the Sargasso. Most of it comes from studies in Sweden, where they stock eels and they could not get them out of the Baltic. But there are other studies that have shown that they get out. Ultimately, we have not shown any *Anguilla* to the Sargasso, so it is a little bit unfair. But, they have their issues with the Saint Lawrence, and the exchange and stocking to the Saint Lawrence. We have not seen that in Europe, but there is something going on there, which is very intriguing. Particularly in this x-ratio we always used to think that eels do not decide if they are going to be male or female until they are about 25 centimetres long, but that was just because that was the size at which we could see them. There was an aquaculture study which suggested that they make the decision within 90 days after settling in the Sargasso. What you in

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<sup>10</sup> Research Scientist, Department of Fisheries and Oceans, Institut Maurice-Lamontagne.

Canada are showing are that they are made a long time before we can actually see it, so we have to be very careful.

**Matt Gollock:**

I do not know how prevalent this is, but sometimes what will happen is eels will be stocked from farms, but what will often happen is the fast growers will be removed for sale and the slow growers will be put in for stocking. If that is the case, if they are potentially not as healthy as the others, then it could be that they are not going to make it to the Sargasso anyway. That is just a practice, and I am not saying that it is widespread, but it is a practice.

**James McCleave:**<sup>11</sup>

Just a quick follow up, Alan [Walker]: if certain percentages of glass eels can be used for/allocated for stocking, is there any pressure to do those stockings within a drainage basin or can they go anywhere?

**Alan Walker:**

ICES has certainly advised you should move them as little distance as possible, but it is only advice. There is no actual power behind that. And there is no decision by anybody that they have to abide by that.

**James McCleave:**

I am thinking about the studies that you mentioned from Sweden, Germany, and maybe from Poland where stocked eels cannot seem to find their way out of the Baltic. But maybe if there were translocations within the drainage then that problem may not exist. I do not know.

**Alan Walker:**

But the problem is the Baltic has so little recruitment. . . .

**Mitch Feigenbaum:**

When you talk about the 65% that has to be devoted to stocking and 35% can go to aquaculture: if the eel is going to stocking via aquaculture does that count toward the 65%? Because when Matt [Gollock] mentioned that they might be selling runts, I do not know how widespread a problem it is – think about it. What do you think they are going to do if they are selling stocked eels, send you the fast growers?

**Alan Walker:**

In theory, yes. If they go to stocking through aquaculture, then yes. But the only way they can manage it at the moment because there is no international coordination of the supplier eels is

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<sup>11</sup> Professor Emeritus, School of Marine Sciences, University of Maine.

whatever the first buyer says is going to happen to the eels, that's what determines what category you fall into.

**Charles Norchi:**<sup>12</sup>

A question for David [Freestone] on the seabed mining: how big a threat is it in the Sargasso Sea and how are you going to head it off?

**David Freestone:**

That is a good question, and very different from the others. Certainly there are potential sites. What is really interesting is that there is a group within Bermuda itself which are talking about seabed mining. . . . There are some [possible] sites around the seamounts around Bermuda, certainly to the north and in the EEZ which are potential sites. [There may also be some sea mounts in the Sargasso Sea ABNJ. The Sargasso Sea Commission now has Observer Status with the International Seabed Authority and are discussing an MOU with them.] In the Clarion Clipperton Zone in the Pacific they have designated some areas of particular environmental interest which are no mining zones. We are keen to [see if this concept might be applied to] other areas as well, such as the Sargasso Sea EBSA.

**Mike Waine:**<sup>13</sup>

My question is about management in the E.U. You have these management plans, I am just wondering how that matches up with the countries that have been able to implement the management, are those the larger countries for harvesting purposes? How does that relate? Are the largest harvesting countries implementing the plans and taking these reductions?

**Alan Walker:**

In terms of the 50%, if you did not have to take the 50% off, that is quite rare. In terms of fisheries in general and production in general, it is better than that. Most of the countries who have to do something have done something regardless of how big they are. The countries into the Baltic have relied on stocking for a long time, so their management relies on stocking. Whereas the countries who have more fisheries have or have not taken effects on fisheries.

**Bradnee Chambers:**

I think that winds up the panel. I want to thank the panelists for offering us a really rich debate, discussion, and presentations.

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<sup>12</sup> Director, Center for Oceans and Coastal Law, University of Maine School of Law.

<sup>13</sup> Senior Fishery Management Plan Coordinator, Atlantic States Marine Fisheries Commission.